Telecommunications Distribution Design Guide

Telecommunications Infrastructure Standards

Revision 5.0.1

Washington State Department of Corrections

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1 PREFACE

A. The Telecommunications Distribution Design Guide (TDDG) is written to communicate the requirements of the Washington State Department of Corrections (DOC) for design and installation of telecommunications distribution systems at both DOC-owned and leased facilities. The TDDG is written for architects, engineers and designers responsible for the design of new or remodeled facilities for DOC where telecommunications infrastructure currently exists or will be installed. It is also intended for other low voltage telecommunications contractors installing telecommunications infrastructure at DOC facilities, including DOC personnel and inmate work crews, when a formal design is not developed.

B. The TDDG has been developed from information contained in Revision 4 of DOC's Telecommunications Infrastructure Standards (TIS) published in April 2000 and reflects current industry methods, materials and Standards. The TDDG reflects DOC and Industry Standards in effect as of this publication.

C. It is the responsibility of the telecommunications distribution designer to coordinate with the other designers on a project (architectural, electrical, HVAC, etc.) to determine that other systems are both compatible with and complementary to the communications cabling system. DOC agrees with BICSI's design philosophy that it is critical to coordinate between disciplines during the design phase of a project, rather than making adjustments in the field during construction.

1.1 LOW VOLTAGE SYSTEMS

Wherever practical, telecommunications pathway and cabling systems designed for DOC facilities are expected to support and integrate low voltage systems that convey information within and between buildings. Telecommunications infrastructure shall be designed in accordance with the requirements in this document to support the Ethernet communications channels on low-voltage devices. Throughout this document, references to "low voltage systems" shall apply as discussed below:

A. The common outside plant (OSP) telecommunications ***pathway*** infrastructure is intended for shared use by the following low-voltage systems, in addition to voice and data systems:

- Building Automation Systems
- Closed Circuit Television Systems (Analog)
- Video Systems (Digital)
- Energy Management Systems
- Environmental Control Systems
- Fire Alarm Systems
- Security Systems
  - Access Control Systems
  - Alarm Systems
- PLC Control Systems

B. The common outside plant telecommunications media shall be 62.5/125 micron multimode fiber optic cable, singlemode fiber optic cable and 24 AWG unshielded twisted pair (UTP) copper cable (Category 3-rated). The common outside plant

(OSP) telecommunications cable ***media*** is intended for shared use by the following low-voltage systems, in addition to voice and data systems:

- Building Automation Systems
- Energy Management Systems
- Video Systems (Digital)
- Environmental Control Systems

C. The common inside plant telecommunications media shall be 62.5/125 micron multimode fiber optic cable and 24 AWG unshielded twisted pair (UTP) copper cable (Category 6-rated). The common inside plant (ISP) telecommunications ***pathway*** is intended for shared use and the common ISP telecommunications ***media*** is intended for separate use by the following low-voltage systems, in addition to voice and data systems:

- Video Systems (Digital)
- PLC Control Systems (for PC-to-processor communications)

Inside plant telecommunications infrastructure intended to support Ethernet communications (or other similar protocols for security and fire alarm systems) shall be designed in accordance with the inside plant telecommunications infrastructure requirements in this document. However, due to the critical nature of these systems, inside plant pathway and cabling serving these systems shall homerun to a "Security Electronics Room" (also known as the Low Voltage Electronics Room) rather than to common shared telecommunications rooms.

D. Where low-voltage systems require different media (other than fiber optic cabling and 24 AWG UTP) the systems shall be designed to comply with the pathway and space requirements of this document wherever practicable.

1.2 DOCUMENT INTENT

A. DOC has standardized on the ANSI/TIA/EIA[1] Commercial Building Telecommunications Standards series and has adopted the BICSI[2] *Telecommunications Distribution Methods Manual* (TDMM), the BICSI *Customer-Owned Outside Plant Design Manual* (CO-OSP) and the BICSI *Telecommunications Cabling Installation Manual* (TCIM) as the basis for communications distribution design in DOC facilities. The DOC TDDG is the guide to the application of the ANSI/TIA/EIA Standards, the BICSI TDMM, the BICSI CO-OSP and the BICSI TCIM to the unique circumstances present in DOC facilities and projects.

B. The TDDG is not intended to replace or detract from the TDMM or CO-OSP. Rather, this document is to be used in conjunction with the TDMM and CO-OSP in order to reinforce selected TDMM content as well as highlight any restrictions and

[1] Effective December 29, 2000, The Washington State Department of Information Systems has mandated that all Washington State Agencies adopt the ANSI/TIA/EIA Commercial Building Telecommunications Standards as the basis for communications distribution design in State facilities (see *Computing and Telecommunications Architecture Standards – Building Wiring,* http://www.wa.gov/dis/portfolio/).

[2] The BICSI TDMM is widely considered to be the industry reference text for the design of standards-compliant communications distribution systems (see http://www.bicsi.org/manuals.htm). BICSI, 8610 Hidden River Pkwy, Tampa, FL 33637-1000 USA; 1-800-242-7405; http://www.bicsi.org

limitations on TDMM and CO-OSP content in order to meet the specific requirements of DOC facilities.

C. This document addresses communications distribution system design for use within a building and between buildings on a contiguous site for all telecommunications, low voltage and signal systems as related to:
- Telecommunications Spaces – Entrance facilities, equipment rooms and telecommunications rooms
- Intra-building Backbone Distribution – Pathway and raceway requirements, communications media requirements
- Horizontal Distribution – Pathway and raceway requirements, communications and low voltage media requirements, requirements for special work areas
- Outside Plant Backbone Distribution – maintenance holes, handholes, ductbanks, ducts (conduits), communications and low voltage media requirements

D. Unless otherwise stated, the requirements defined in the TDDG apply to both new construction, renovation and remodel projects and as appropriate to leased facilities.

E. Some areas within DOC facilities are described as either "***secured areas***" or "***non-secured areas***". **Secured areas** are defined as those areas where inmates are housed, confined, contained, and have routine unescorted access. The secured area is typically the entire area (and all buildings) within the fenced security perimeter of a correctional institution. Telecommunications cabling and equipment shall be protected from inmate access in the secured area. Access to telecommunications cabling and equipment could provide an inmate with an opportunity to sabotage critical telecommunications or security monitoring systems, and could also provide the inmate with an opportunity to use cable or equipment as a weapon. **Non-secured areas** do not have the same stringent security requirements, and in general, can be treated as a normal business operations area.

F. This document provides directions for making standards-compliant design decisions that will, in due course be reflected in Construction Documents. The Construction Documents for a project will be comprised of drawings and a system specification that properly incorporates telecommunications infrastructure within a project. The TDDG shall be used in conjunction with the DOC Telecommunications Construction Guide Specification (TCGS). Drawings shall conform to the requirements contained in this document for content and completeness, and the specifications shall be based upon the TCGS.

G. This document uses many terms and abbreviations that are common in the telecommunications industry. While a glossary is included in the Appendix at the end of this document, please refer also to Chapter 3 of the BICSI TDMM and also the Glossary section at the end of the BICSI CO-OSP for further information.

H. Adherence to and compliance with the codes, standards and industry practices listed below along with the DOC requirements contained in this document is mandatory.
- Washington State Rules and Regulations for Installing Electrical Wires and Equipment (RCW 19.28, WAC 296-46 and WAC 296-401A)
- Washington State Department of Labor and Industries Safety Standards for General Safety and Health (WAC 296-24 Volume 1 Part L)
- National Electrical Safety Code, American National Standard C2
- National Electrical Code, NFPA 70
- ANSI/TIA/EIA Commercial Building Telecommunications Standards series
- Fiber Optic Test Standards, TIA/EIA 455 (Series)
- Optical Fiber Systems Test Procedures, TIA/EIA 526 (Series)
- Local Area Network Ethernet Standard, IEEE 802.3 (Series)

I. All references to the following manuals within the TDDG and TCGS shall specifically address only the editions specified below. Newer editions shall not be used for reference until authorized by DOC in writing or through a revised edition of the TDDG:
- BICSI Telecommunications Distribution Methods Manual (9TH Edition)
- BICSI Customer-Owned Outside Plant Design Manual (2nd Edition)
- BICSI Telecommunications Cabling Installation Manual (3rd Edition)

J. Requests to deviate from the DOC requirements may be submitted on a case-by-case basis, in accordance with the instructions in the Project Procedures section of this document. No deviation from the requirements of the National Electrical Code will be allowed. For further information regarding codes and standards, please refer to Chapter 2 in the BICSI TDMM as well as the BICSI CO-OSP Bibliography.

K. The requirements contained in the TDDG are considered to be in addition to those listed in *Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services* and the *State of Washington Conditions of the Agreement*. Where the requirements differ, the issue shall be brought to the attention of the DOC Project Manager - otherwise the more stringent requirement shall apply.

1.3 DOCUMENT STRUCTURE

The TDDG is organized in six sections:

A. The **Preface** (this section) describes this document, its intent and its relationship to industry standards and practices. It also describes how to use this document.
1. Preface
2. DOC Policies
3. Project Procedures
4. Design Criteria
5. Construction Document Content
6. Appendices

B. The **DOC Policies** section describes internal DOC telecommunications policies requirements, standard practices and processes associated with designing, installing and operating telecommunications infrastructure.

C. The **Project Procedures** section describes the required qualifications for telecommunications designers as well as the procedures that designers must follow when working on telecommunications infrastructure projects at DOC facilities. It includes activities that are required throughout the project as well as phase-specific requirements.

D. The **Design Criteria** section serves two purposes. The first is to describe the general requirements for DOC telecommunications infrastructure along with the typical features required for different categories of building spaces and construction types. The second purpose is to place limitations on the materials and methods described in the BICSI TDMM and CO-OSP. While the TDMM and CO-OSP describe many materials and methods that are generally accepted in the industry for providing telecommunications infrastructure, DOC facilities have some unique characteristics that impose limitations on some of the materials and methods that otherwise might be acceptable. Some of the practices discussed in the TDMM and CO-OSP are expressly prohibited in DOC facilities. Other practices are permitted in certain areas (non-secured areas, for example) but prohibited in other areas (secured areas). ***Generally speaking, if the BICSI TDMM and CO-OSP do not describe a particular material or method for use with telecommunications distribution infrastructure, it will not be allowed for DOC facilities. In addition, the DOC TDDG places further restrictions on the use of some materials and methods that the BICSI design guidelines support.***

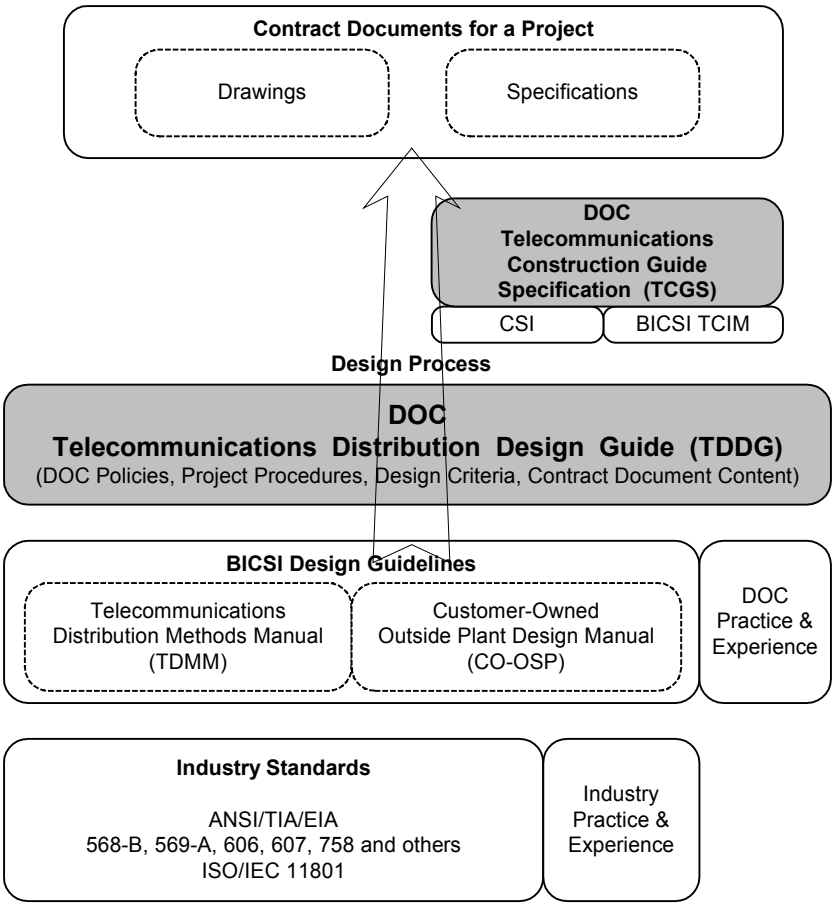
E. The **Construction Document Content** section defines the minimum level of detail that DOC requires to be present in the telecommunications portion of the Construction Documents for a project. In this section, the required types of details along with the content in the details are both described. This section also briefly describes how to use the TCGS for producing the specification for a particular project. More detailed instructions for producing a project specification based on the TCGS are included with the TCGS.

F. The **Appendices** section provides standard forms and diagrams along with example forms and diagrams that are required for DOC telecommunications infrastructure designs.

1.4 HOW TO USE THIS DOCUMENT

The following diagram depicts the relationships between the ANSI/TIA/EIA Standards, the BICSI Design Guidelines, the DOC documents (TDDG, TCGS) and the project-specific Construction Documents:

DOC Telecommunications Design Process



Telecommunications distribution infrastructure at DOC facilities shall be designed based on the BICSI design guidelines (the TDMM, the CO-OSP and the TCIM) and compliant with the ANSI/TIA/EIA Standards as applied by and illustrated in the DOC TDDG. Designers shall use the TCGS "as written" for creating specifications for a particular project according to the instructions in the TDDG. Rewriting the TCGS or modifying the format or requirements will not be accepted. Designers shall also follow the guidance in the TDDG to create the Construction drawings for a particular project.

1.4.1 DOC PERSONNEL

A. The DOC Telecommunications Policy section of this document applies specifically to DOC personnel. In addition to the DOC Telecommunications Policy section, DOC personnel should be aware of the instructions, requirements and guidelines for Designers contained in the other sections of this document. Also, the TCGS contains additional requirements related to telecommunications distribution system materials and installation methods applicable at DOC facilities.

B. DOC personnel should be familiar with these requirements with respect to their application on both large-scale telecommunications distribution projects and small-scale "moves/adds/changes" projects. These requirements also apply to in-house operations and maintenance of existing telecommunications distribution systems.

1.4.2 TELECOMMUNICATIONS DISTRIBUTION DESIGNERS

Telecommunications distribution designers shall be responsible to apply the guidelines, instructions and requirements in this document along with the "hidden-text" guidelines contained in the TCGS, in the course of designing telecommunications distribution infrastructure at DOC facilities.

1.4.3 CONTRACTORS AND CABLING INSTALLERS

Contractors and cabling installers involved in projects without a formal engineering and design process shall adhere to the requirements of this document and also requirements for telecommunications distribution system materials and installation methods contained in the TCGS.

2 DOC TELECOMMUNICATIONS POLICIES

A. DOC personnel designing telecommunications infrastructure for DOC facilities shall follow the requirements in this document and in the TCGS.

B. Input from DOC IT and site operations staff must be incorporated in developing the initial and on-going construction schedules. This input is especially important when an early or phased turn-up of buildings is required, but is also vital for the initial start-up of a new prison. Timing on the construction of the main telecommunications room and building, and the backbone cable plant connecting it to key buildings, would be a vital consideration in bringing key buildings online at required dates.

C. Management of DOC's Enterprise Network is the responsibility of the IT staff at DOC Headquarters. This includes network design, operations, performance monitoring, optimization, troubleshooting, and disaster recovery. The IT staff at DOC Headquarters is also responsible for the planning and development of operational and design standards for local area networks (LANs) at all DOC facilities, including the telecommunications infrastructure.

D. DOC regional IT staff will be responsible for installation and support of LAN hardware, software data communications, voice systems for both staff and inmate telephones, and certain enterprise network hardware and software.

E. Acquisition of IT services, hardware, software, and related products is the responsibility of DOC IT staff. IT acquisition rules, licensing agreements, and contracts fall under the authority of the Washington State Department of Information Services (DIS), with very detailed delegated authority granted to DOC. DOC IT staff acquiring IT goods and services are accountable for ensuring that the procurements meet DOC technology standards and that the acquisition process is conducted in compliance with DOC policy, delegated authority, and statutory requirements.

2.1 DOC PERSONNEL

2.1.1 TEAM STRUCTURE

DOC requires the following DOC personnel to work closely (as a team) with the architects, engineers and designers throughout the entire project life cycle, starting at the preliminary design phase:

- DOC IT Infrastructure Specialist
- DOC Regional Information Technology Manager (ITM)
- DOC Capital Planning and Development (CPD) Project Manager
- A designated project RCDD (if one is assigned to the project)

2.1.1.1 DOC IT Infrastructure Specialist

The DOC IT Infrastructure Specialist's responsibilities are to:

- Improve communication on capital projects
- Ensure that relevant DOC regional, management, and specialized technical staff are informed and involved on all telecommunications infrastructure activities (design, construction, support, and maintenance)
- Ensure that installed facility infrastructure meets DOC standards
- Keep the DOC IT Network Operations Manager informed of all telecommunication infrastructure activities, and evaluate requests for alternative design solutions.

2.1.1.2 DOC Regional Information Technology Manager (ITM)

Within their assigned state region, the DOC Regional ITM's are responsible:

- For all information technology issues and support services relating to DOC facilities
- To be IT liaisons to the Office of Correctional Operations management
- To review and coordinate all telecommunication infrastructure activities
- To review Alternative Design Requests forwarded by the DOC IT Infrastructure Specialist.

2.1.2 DOC PERSONNEL AND INMATE WORK CREWS

A. DOC personnel who install telecommunications infrastructure at DOC facilities (with or without supervised inmate work crews) must be familiar with the requirements of this document. They must also be familiar with and have a current copy of both ANSI/TIA/EIA-568-B & 569-A.

B. Telecommunications pathway work (both inside plant and outside plant), when performed by DOC personnel or an inmate work crew, will require the prior approval of the DOC Regional ITM and DOC IT Infrastructure Specialist. Prior to constructing telecommunications pathway, an RCDD shall be contracted to prepare drawings and specifications for the project. The RCDD shall also be contracted to periodically observe the work while in progress, and upon completion, providing written observation reports following each visit. The RCDD shall also be contracted to produce as-built drawings bearing the RCDD's logo stamp and signature.

C. Use of an RCDD is required for all telecommunications infrastructure work performed by DOC personnel or an inmate work crew. The DOC Regional ITM and DOC IT Infrastructure Specialist may agree to waive the requirement to use an RCDD for the design documentation, engineered specifications, and observation of horizontal distribution pathway (inside plant conduit) on a case-by-case basis. The waiver must be submitted in writing to the DOC Plant Manager with a copy to the DOC IT Network Manager. This waiver cannot be granted for outside plant telecommunications pathway or telecommunications maintenance hole / handhole work.

2.2 INITIATING NEW PROJECTS

All telecommunications infrastructure and substructure activity, regardless of the size or scope of the project, or quantity of cable involved, must have prior written approval from the authorized DOC IT staff listed below to proceed with the design and/or installation.

2.2.1 PRIOR APPROVAL REQUIREMENTS

A. For new construction and major renovations or remodeling of existing structures, prior written approval must be obtained from the DOC IT Infrastructure Specialist.

B. For all other telecommunications infrastructure activity, prior written approval must be obtained from the DOC Regional ITM.

C. Requests for approval must be submitted in one of the three following forms:
- As part of the technical design development process
- On a DOC Professional and Technical Request (P&T) document
- On a DOC electronic e-mail Procurement and Purchase Justification (PRJ) document.

D. This includes new construction, renovation of existing structures, upgrading telecommunications infrastructure to support new technology, upgrading telecommunications infrastructure to meet new standards, infrastructure to support other agencies or tenants at DOC facilities, and all moves, adds, and changes (MACs) at DOC facilities, including MAC work performed by DOC personnel.

2.2.2 NEW CONSTRUCTION

New construction projects shall include telecommunications infrastructure designed and installed in accordance with the requirements of this document.

2.2.3 RENOVATION TO EXISTING STRUCTURES

DOC facilities undergoing renovation or remodeling projects shall incorporate telecommunications infrastructure in the project, designed and installed in accordance with the requirements of this document.

2.2.4 UPGRADING TELECOMMUNICATIONS INFRASTRUCTURE TO SUPPORT NEW TECHNOLOGY

DOC will occasionally install new information technology systems at a facility where the existing telecommunications infrastructure is inadequate for the new application. It is the responsibility of the organizational element sponsoring the installation of the new technology to ensure that the telecommunications infrastructure is capable of supporting the new technology, or that it be upgraded to support the new technology. Any upgrades made to the telecommunications infrastructure shall meet the requirements of this document.

2.2.5 UPGRADING TELECOMMUNICATIONS INFRASTRUCTURE TO MEET NEW STANDARDS

Unless an upgrade is required to correct a code violation, there is no requirement to upgrade existing telecommunications infrastructure at any DOC facility simply to meet industry standards or the requirements of this document.

2.2.6 INFRASTRUCTURE TO SUPPORT OTHER AGENCIES OR TENANTS AT DOC FACILITIES

Other state agencies (such as the Department of Natural Resources or the Department of Social and Health Services) often occupy buildings at DOC facilities or institutions. Also, some private businesses have contracts with Correctional Industries, and inmate telephone service is provided on DOC property under contract with a telephone company. As the owner of the property, it is normally incumbent on the DOC to provide the telecommunications infrastructure to support other agencies or tenants at DOC facilities. The terms and conditions for reimbursement of any expenses incurred by the DOC to provide telecommunications support to other agencies will be negotiated and documented in the contract or an interagency support agreement with the tenant.

2.2.7 DAMAGE TO EXISTING TELECOMMUNICATIONS INFRASTRUCTURE

A. Construction, maintenance and other activities may result in damage to telecommunications infrastructure, including cabling.

B. In the event of damage to telecommunications infrastructure, regardless of the cause or party responsible, the local DOC staff shall immediately contact the DOC IT Infrastructure Specialist, who will determine the repair or replacement strategy for the damaged infrastructure.

C. The DOC IT Infrastructure Specialist shall:
   1. Work with the local DOC staff to identify any potential methods of emergency, interim repairs.
   2. Identify the steps necessary to assess whether the damaged infrastructure can be repaired or whether it must be replaced.

D. The party responsible for the damage to the telecommunications infrastructure shall be responsible for the total cost of all emergency, interim repairs and all replacement costs.

E. All damaged infrastructure shall be restored to within the scope of the original design/installation parameters. This shall include, but not be limited to all repair or replacement work performed by a certified Avaya Value Added Reseller (VAR) of DOC's choosing, all testing and recertification of the infrastructure for full compliance to DOC's Telecommunications Standards and applicable Avaya Communication SYSTIMAX SCS warranty.

2.3 PROCUREMENT AND INSTALLATION POLICY

A. The primary responsibility for the management and use of information systems, telecommunications, and information technology equipment, software, and services rests with each state agency head. Equipment is defined as machines, devices, and transmission facilities used in information processing, such as computers, telephones, and cables. This section highlights certain procurement policies applicable to the telecommunications infrastructure. Readers should consult the Department of Information Services Policy and DOC Policy for the Acquisition and Disposal of Information Technology Equipment for complete details.

B. There are two general methods used for the procurement and installation of the telecommunications infrastructure. In larger construction projects, the telecommunications infrastructure installation might either be part of the general construction contract or it could be a separate contract.

C. Use of the DIS Master Contract is recommended whenever possible. A competitive acquisition should be pursued with the contractors listed on the DIS Master Contract web site[3]. The procurement of telecommunications infrastructure in large construction projects is a combined effort between the DOC CPD Project Manager and the DOC IT Infrastructure Specialist.

D. The following policies and procedures apply to the planning and management of telecommunications infrastructure installation as a separate (non-public works) project:

2.3.1 PROCUREMENT POLICY FOR INFORMATION TECHNOLOGY EQUIPMENT

The Department of Information Services (DIS) manages the state policy for the acquisition of information technology equipment. DIS grants DOC a delegated level of acquisition authority based on an IT portfolio style strategic plan submitted to and approved by DIS and the Washington State Office of Financial Management (OFM) on an ongoing basis. All IT projects with total acquisition and five year operational costs of $200,000 or more require a written IT Acquisition Plan that must have prior approval by DOC IT management. Large IT projects with total acquisition and five-year operational costs exceeding $1,000,000 require prior approval by DIS.

2.3.1.1 DOC Headquarters Information Technology Approval

In order to achieve consistent and competent technical design in compliance with this document and to ensure compliance with DIS procurement requirements, DOC acquisitions and installations of telecommunications infrastructure or substructure must have the prior approval of DOC IT. Requests for approval shall be submitted to the DOC IT Infrastructure Specialist via the Regional Information Technology Manager (ITM).

[3] As of this publication, the web site address is: http://emall.dis.wa.gov/Contracts/MasterContract.asp

Requests for approval must include a description of the acquisition and installation and identify the following:

- Source of funding
- RCDD for design services
- RCDD for construction observation services (optional)
- Avaya Communication SYSTIMAX® SCS cable installer

2.3.1.2 Criteria and Methods for Acquisition

A. DOC may acquire information technology (IT) resources by conducting a new competitive solicitation, by using an existing DOC contract or DIS Master Contract, in limited cases through a sole source method, through strategic partnerships, or by transferring the resource from one agency to another.

B. The most efficient, cost effective, and preferred method for procuring telecommunications infrastructure installation services is through the use of the pre-existing DIS Master Contracts for Cabling Equipment, Installation and Maintenance. Contact the DOC Office of Administrative Support, Information Technology for details.

C. For additional methods of acquisition, refer to the Department of Information Services Policy for the Acquisition and Disposal of Information Technology Equipment.

2.3.1.3 Avaya Communication SYSTIMAX® Products and Approved Alternatives

The majority of DOC facilities have an installed base of Avaya Communication SYSTIMAX® Structured Cabling System (SCS) products (formerly known as Lucent Technologies). Standardization on this product line ensures that DOC technical personnel are familiar with the installed infrastructure components at all facilities, and that they are prepared to handle moves, adds, and changes to the infrastructure. Standardization also ensures that there will be performance compatibility with the installed base when additions are made to the infrastructure, and that spare parts and components from one facility can be used at other facilities as needed.

A. Where additions are made to existing facilities that currently use Avaya Communication SYSTIMAX® SCS products (including new buildings on an existing campus) the addition shall exclusively use Lucent Technologies SYSTIMAX® products.

B. Where additions are made to existing facilities that currently do not have an Avaya Communication SYSTIMAX® SCS installation, products from the Avaya Communication SYSTIMAX® SCS product line shall be used with the eventual goal of standardizing on the SYSTIMAX® SCS products.

C. The telecommunications infrastructure design for new facilities shall be based upon the Avaya Communication SYSTIMAX® SCS product line.

2.3.1.4 Sole Source Procurement

Standardization on the Avaya Communication SYSTIMAX® SCS product line does not imply that there is a sole source for procurement or installation of the SYSTIMAX® products. Avaya Communication SYSTIMAX® SCS products can be procured through multiple supply sources, and installation can be procured through multiple Avaya Communication SYSTIMAX® SCS certified cable installation contractors using competitive solicitations and existing contracts. Refer to *Section 2.3.1.2 - Criteria and Methods for Acquisition*, above.

2.4 LARGE TELECOMMUNICATIONS PROJECTS

Telecommunications infrastructure installation projects may be standalone projects to prepare for the installation of new technology, or a separate project concurrent with a locally managed public works project.

2.4.1 DESIGN PHILOSOPHY

A. An engineered telecommunications design is required for all new construction, major renovation or remodeling, including technical specifications and drawings to be used as the basis for competitive bidding for the construction contract. An engineered telecommunications design will also be developed for projects where DOC personnel or inmate work crews will be used for construction.

B. DOC requires the use of Registered Communications Distribution Designers (RCDD) to design the telecommunications distribution infrastructure for all new construction, major renovation or remodeling, major telecommunications upgrades, and all telecommunications infrastructure work performed by DOC personnel or inmate work crews. The RCDD designation is recognized worldwide as a design professional that has met specific professional design experience requirements and has successfully completed an extensive examination on the subject of telecommunications distribution design. RCDDs are employed by architectural and engineering firms, and also by telecommunications infrastructure installation contractors.

C. Telecommunications infrastructure shall be designed and installed in accordance with applicable codes and industry standards. Due to the unique physical characteristics and security requirements of many DOC facilities, some technical design solutions are better suited than others. This document identifies which design solutions are appropriate for and approved for common types of buildings and areas at DOC facilities.

D. Telecommunications infrastructure design shall be incorporated during the preliminary design phase of each project. This will provide DOC IT the opportunity to influence the design from the start and address telecommunications requirements at appropriate points in the design process. It is imperative that the A/E firm work closely with the designated project RCDD, the DOC IT Infrastructure Specialist, and the DOC CPD Project Manager from the start of each project.

2.5 SMALL TELECOMMUNICATIONS PROJECTS

A. Depending on the size and scope of a small project, the DOC IT Infrastructure Specialist will determine whether an engineering firm is required to develop a telecommunications distribution design.

B. For small projects or installation of additional cabling, a certified Avaya Communication SYSTIMAX® SCS installation contractor can be hired for a limited scope installation. The Avaya VAR must be on the approved list maintained by the DOC IT Infrastructure Specialist, and be currently listed as a contractor on the DIS Cabling Master Contracts. The only alternative to using a certified Avaya Communication SYSTIMAX® SCS contractor (for copper cabling installation only) is to use DOC personnel who are certified as Avaya Communication SYSTIMAX® SCS "self-maintainers". There shall be no exceptions to this requirement. DOC personnel shall not install fiber optic cable under any circumstance.

C. The DOC work order to the AVAYA VAR must be attached to the document titled, "Installation of Telecommunications cabling for Washington State Department of Corrections (WSDOC) Facilities." This document may be obtained from the DOC IT infrastructure Specialist. The AVAYA VAR must state in their contract documents, that they will meet the requirements of the attached DOC document. The project shall not commence until the DOC document is attached and the AVAYA VAR has agreed to comply with its requirements.

2.6 REVIEWING TELECOMMUNICATIONS DESIGNS

2.6.1 ALTERNATIVE DESIGN REQUESTS (ADR)

A. Requests to deviate from industry standards or DOC design solutions will be considered on a case-by-case basis. Any request to deviate from the requirements of the National Electrical Code will not be accepted.

B. Requests to apply alternative design solutions shall be submitted to the DOC IT Infrastructure Specialist for consideration. The ADR will follow the review process as shown in the flow chart in Section 3.4.3 of this document. Approval will only be granted in writing, and it must be authorized by the DOC IT Network Operations Manager. It must also be authorized by the DOC CPD Project Manager if capital funding is involved.

C. For more information, see *Section 3.4.3, Alternative Design Request* in this document.

2.6.2 DESIGN REVIEW PROCESS

A. The Design Review Process will be conducted by DOC at the following points in the design process:
- Schematic Design

- Design Development
- Review Set (99% CD)
- Construction Documents (100% CD)
- Record Drawings

B. The following people will participate in the Design Review Process:
- DOC IT Infrastructure Specialist
- DOC CPD Project Manager
- DOC-selected RCDD Review Consultant (optional)
- Architect/Engineer (Prime Consultant)
- Designer

C. For more information, see *Section 3.2, Design Review Process* in this document.

2.7 TELECOMMUNICATIONS OPERATION AND MAINTENANCE

2.7.1 DOC TELECOMMUNICATIONS INFRASTRUCTURE RESPONSIBILITIES

A. DOC is responsible for providing a cable pathway from the property line to the Entrance Facility (EF). At DOC-leased facilities, the responsibility falls to the building owner who may require leasehold improvement costs to DOC. The cable pathway shall be underground conduit, with telecommunications maintenance holes and handholes as necessary. Close coordination with the different service providers is required to design the entrance cable pathway. Some service providers are not willing to share conduit or utility poles with another service provider, therefore it is important to install one or more spare conduits in the pathway.

B. The service providers' technicians will need access to the EF and DOC is responsible to coordinate and provide escorts as required. Service provider technician access is simplified if the Entrance Facility and Equipment Room are located outside of the Secured Area.

C. DOC is responsible for the installation, maintenance, and troubleshooting of all telecommunications equipment and infrastructure from the demarcation point throughout the facility.

2.7.2 SERVICE PROVIDER RESPONSIBILITIES

The service provider is responsible for providing and installing the entrance cable up to the demarcation point as well as the termination hardware at the demarcation point. In some cases, DOC contracts with the service provider to extend to the demarcation point from the EF to another location at the facility. In such cases, the service provider is also responsible for maintenance and troubleshooting of the extended portion of the cabling and termination hardware. The service provider may also be contracted (for an additional charge) to provide troubleshooting and maintenance services for DOC-owned equipment.

2.7.3 AVAYA COMMUNICATION "SELF-MAINTAINERS"

A. DOC telecommunications cabling systems are covered by a 20-year extended warranty and application assurance program. Therefore, DOC personnel who may be installing telecommunications cabling systems must first obtain certification as a "self-maintainer" through the Avaya Communication SYSTIMAX® SCS manufacturer training and certification program. DOC personnel are required to have the same level of knowledge and skill as required for Avaya Communication SYSTIMAX® SCS certified installation technicians in the private sector.

B. The Avaya Communication SYSTIMAX® SCS manufacturer training is mandatory for DOC personnel who install, move, or make changes to high performance telecommunications cabling because the warranty would otherwise be voided. DOC personnel who are not certified by Avaya Communication as a "self-maintainer" shall not perform moves, adds, or changes at a facility that has Avaya Communication SYSTIMAX® SCS cabling installed. Cabling installations performed by DOC personnel must be tested in accordance with the requirements in the TCGS, and may also be inspected by an RCDD as discussed in this document.

C. DOC personnel who have obtained certification as an Avaya Communication "self-maintainer," but fail to follow required practices during move/add/change (MACs) activities shall surrender their Avaya Communication "self-maintainer" certification to the DOC Regional ITM. The DOC Regional ITM will notify the DOC person in writing they are no longer allowed to make MACs to high performance telecommunications cabling at DOC facilities. The notification shall be copied to their immediate supervisor, the DOC IT Infrastructure Specialist, and the DOC IT Network Manager.

2.7.4 MOVES, ADDS, AND CHANGES

A. Moves, adds, and changes to the telecommunications infrastructure shall be performed in accordance with the requirements of this document. This includes (but is not limited to) all copper or fiber optic cables for the LAN, telephones, workstation area outlets, patch panels, patch cords, etc. All MACs must be coordinated with the DOC IT Regional ITM.

B. DOC personnel shall not install fiber optic cable.

2.7.4.1 Splitting of Cable Pairs

A. In certain situations it may be necessary to use one or two pairs of a four (4)-pair cable to support one telephone device, and to use the remaining pairs to support a different telephone device. In these situations, the splitting of the pairs shall be accomplished with a line-splitting device installed on the outside of the Information Outlet faceplate. At the telecommunications closet, individual cross-connect wires connected to the 110 Termination Field may be used to cross-connect the services.

B. Under no circumstances will the splitting of data cable pairs be allowed. The integrity of all four (4)-pair cable [all eight (8) wires] must be maintained end-to-end for the LAN equipment.

C. Under no circumstances will cable pairs be split or removed from the back of a modular Information Outlet or patch panel. All four (4) pairs of each horizontal distribution cable must be terminated to a single eight (8)-position, eight (8)-conductor jack.

2.7.5 ELECTRICAL POWER IN TELECOMMUNICATIONS ROOMS

A. Each telecommunications room (TR) will be equipped with orange-colored power outlets that are dedicated for use by telecommunications equipment. These outlets shall be used exclusively for telecommunications equipment and shall not be used for general-purpose or utility devices such as electric drills, vacuum cleaners, coffeepots, etc.

B. Each TR will also be equipped with white, gray, or beige-colored power outlets that are available for use with non-telecommunications equipment.

2.7.6 TELECOMMUNICATIONS ADMINISTRATION

A. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, telecommunications closets, and other telecommunications spaces. ANSI/TIA/EIA-606, the Administration Standard for the Telecommunications Infrastructure of Commercial Buildings is the industry standard for administering and documenting the telecommunications infrastructure. The purpose of this industry standard is to provide a uniform administration scheme that is independent of applications, which may change several times throughout the life of a building. The TDDG and TCGS establish guidelines and requirements for DOC personnel, end users, manufacturers, installers, and facilities administrators involved in the administration of the telecommunications infrastructure at DOC facilities.

B. All DOC facilities shall maintain a system for documenting and administering the telecommunications infrastructure. DOC personnel shall be responsible for maintaining the telecommunications-related documentation and it is the responsibility of the DOC Regional ITM to ensure that cable and equipment records are maintained for each facility within his/her region. The administration system shall include cable records, and equipment records for all information technology systems. The administration system shall follow the ANSI/TIA/EIA-606 standard.

C. DOC's telecommunications administration system is based on "records" and "identifiers."

D. Records are a collection of information about each specific component of the telecommunications infrastructure. Drawings, details, diagrams, specifications, spreadsheets and databases are all examples of telecommunications records.

E. Records shall be maintained electronically. Paper records are encouraged, but are optional. Record drawings (as-built drawings) are a vital component of the telecommunications administration system, and must be kept current as adds, moves, and changes take place. It is the responsibility of the DOC Regional ITM to ensure that as-built drawings are maintained for each facility within his/her region.

F. For more information about telecommunications records, see *Section 5.25, Cable Records* in this document.

G. Telecommunications records show unique "identifiers" for each component of the telecommunications infrastructure. For more information about identifiers, see *Section 4.13, Telecommunications Administration* in this document and also *Sections 16740 and 16741* in the TCGS.

3 PROJECT PROCEDURES

A. The Project Procedures section contains requirements for architects, engineers and telecommunications distribution designers regarding DOC procedures for projects that include telecommunications distribution systems. This applies both to projects that entail primarily telecommunications distribution work (such as telecommunications infrastructure replacement projects) as well as to architectural projects and other work (such as a new building or campus) that involve telecommunications design.

B. This section is not intended to supersede the requirements in the State of Washington *Conditions of the Agreement* or the *Instructions for Architects and Engineers*, but rather to complement them, providing additional requirements that apply specifically to telecommunications distribution design projects at DOC facilities.

C. It is intended that the requirements in this section be considered contractually binding for design professional firms providing telecommunications distribution design services.

3.1 DESIGNER QUALIFICATIONS

A. For the purposes of this document, the term "Designer" shall mean a Registered Communications Distribution Designer (RCDD) who is currently in good standing with BICSI. This means that the telecommunications design shall be produced by the RCDD. Telecommunications-related communications between DOC and the telecommunications consultant shall be mainly through the RCDD. On projects where the RCDD is not the prime consultant, the RCDD shall keep the prime consultant (Architect/Engineer (A/E)) informed of all direct communications with DOC.

B. The RCDD shall affix his/her RCDD logo stamp (showing the registration number and expiration date) and signature to the final Construction Documents (drawings and specifications) pertaining to the telecommunications distribution design.

3.2 DESIGN REVIEW PROCESS

As noted in Section 6 titled "Procedures Related To Project Phases", the project documents will pass through the design review process at the end of each design phase plus follow-up reviews when necessary. These requirements are in addition to those contained in the *State of Washington Conditions of the Agreement and the Instructions for Architects and Engineers*.

The following steps correspond to the numbered activities shown on the Design Review Process diagram below:

① Each time a review is required, the A/E shall provide copies of the complete project documents set (drawings and specifications for all disciplines involved in the project) submitted to the following people:

- DOC Capital Planning and Development (CPD) Project Manager (PM)
- DOC IT Infrastructure Specialist
- RCDD Review Consultant[4] (*two sets*)

ⒶⒷ The RCDD Review Consultant will have 3, 5, or 10 days (depending on the project phase) to review the design documents and provide written RCDD Review Comments to the DOC CPD PM and the DOC IT Infrastructure Specialist.

②③④ The DOC CPD PM and the DOC IT Infrastructure Specialist will have 5, 8, or 10 days (depending on the project phase) to review the design documents and the RCDD Review Consultant's comments. The DOC IT Infrastructure Specialist will create the DOC IT Review Report, and incorporate the RCDD Review Comments into the report. Following their review, they will distribute the complete set of comments to the RCDD Review Consultant and hold brief discussions about the comments. If there is no RCDD Review Consultant assigned to the project:

- The A/E and Designer shall meet with DOC IT Infrastructure Specialist to initiate the review process.
- The DOC IT Infrastructure Specialist will create the DOC IT Review Report without RCDD Review Comments
- The DOC IT Review Report will then be sent to the DOC CPD PM for review

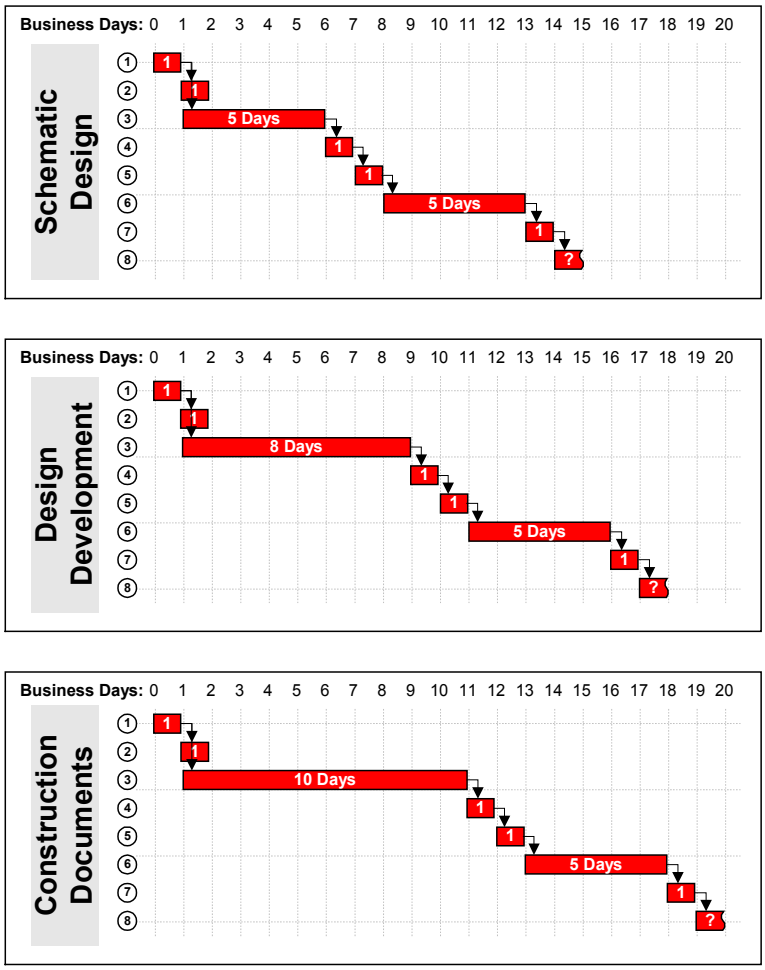
⑤⑥ Following the meeting, the DOC CPD PM will submit the RCDD Review Report to the Designer. The Designer will then be given five days to review the comments and respond to them in writing. Negative responses to any comment shall include a discussion of the reasons for non-compliance.

⑦⑧ Finally, a meeting or teleconference will be held with the DOC CPD PM, the DOC IT Infrastructure Specialist, the RCDD Review Consultant and the Designer to discuss the review comments and the Designer's responses. Following the meeting, the Designer shall revise the design in accordance with the DOC's resolution for each comment.

[4] On some projects, DOC may hire an RCDD Review Consultant to act in the capacity of an independent reviewer and consultant to DOC. The RCDD Review Consultant will be responsible to review the overall design, paying particular attention to areas of the design that are related to the current or future operation and maintenance of the telecommunications system, and sometimes low voltage systems other than voice and data. The RCDD Review Consultant will identify issues that do not appear to be compliant with the requirements in the TDDG and the requirements contained in the TCGS.

The following diagram depicts a typical telecommunications design review process when an RCDD Review Consultant is not involved in the review process. The number of days listed for #3 and #6 may need to be adjusted based on the scope or depth of the telecommunications infrastructure on a project.

Design Review Process Without an RCDD Review Consultant



1. Designer ships Drawings and Specifications to DOC IT Infrastructure Specialist, and DOC Capital Planning and Development Project Manager (DOC CPD PM)

2. DOC CPD PM reviews the drawings and the specifications.

3. Architect and Designer meet with DOC IT Infrastructure Specialist to initiate the review process. DOC IT Infrastructure Specialist then reviews the drawings and specifications and then produces the DOC IT Review Report.

4. DOC CPD PM, and the DOC IT Infrastructure Specialist meet to discuss and finalize the DOC IT Review Report.

5. DOC CPD PM issues the DOC IT Review Report to the Designer for response.

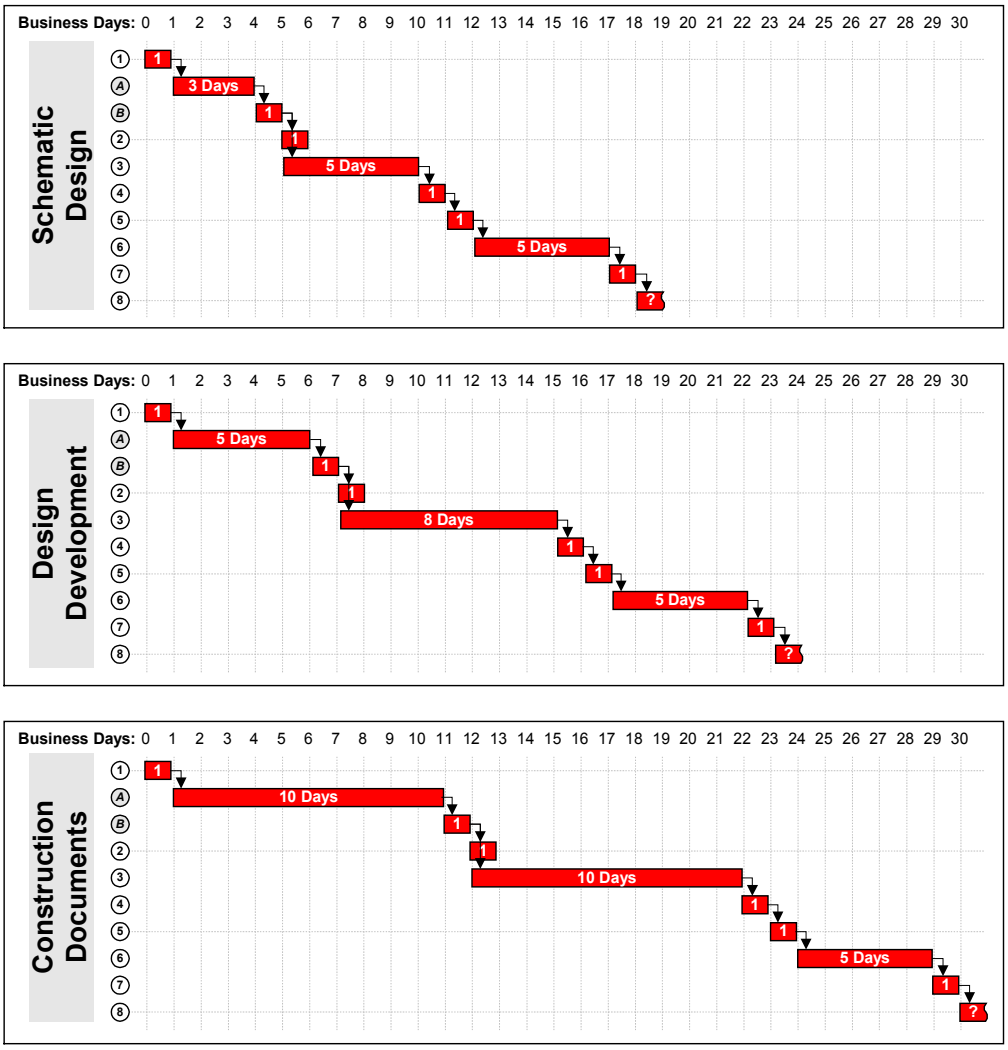
6. The Designer reviews the DOC IT Review Report and provides a written response for each comment to the DOC IT Infrastructure Specialist, and DOC CPD PM.

7. DOC CPD PM, DOC IT Infrastructure Specialist, and the Designer meet to discuss the Designer's responses to the DOC IT Review Report and determine a course of action for each item.

8. The Designer shall revise the design per the direction given in Step 7 (above). The Designer shall then submit a second written response to the DOC IT Review Report, indicating how each comment was resolved.

The following diagram depicts a typical telecommunications design review process, including the RCDD Review Consultant's role in the review process. The number of days listed for #3 and #6 may need to be adjusted based on the scope or depth of the telecommunications infrastructure on a project.

Design Review Process Involving RCDD Review Consultant



1. Designer ships Drawings and Specifications to RCDD Review Consultant, DOC IT Infrastructure Specialist, and DOC Capital Planning and Development Project Manager (DOC CPD PM)

A . RCDD Review Consultant reviews the drawings & specifications and produces RCDD Review Comments.

B . RCDD Review Consultant ships the RCDD Review Comments to DOC CPD PM, and DOC IT Infrastructure Specialist.

2. DOC CPD PM reviews the RCDD Review Comments, the drawings and the specifications.

3. DOC IT Infrastructure Specialist reviews the RCDD Review Comments, drawings and specifications and then produces the DOC IT Review Report, incorporating the RCDD Review Comments.

4. DOC CPD PM, the RCDD Review Consultant, and the DOC IT Infrastructure Specialist meet to discuss and finalize the DOC IT Review Report.

5. DOC CPD PM issues the DOC IT Review Report to the RCDD Review Consultant and to the Designer for response.

6. The Designer reviews the DOC IT Review Report and provides a written response for each comment to the RCDD Review Consultant, DOC IT Infrastructure Specialist, and DOC CPD PM.

7. DOC CPD PM, DOC IT Infrastructure Specialist, the RCDD Review Consultant and the Designer meet to discuss the Designer's responses to the DOC IT Review Report and determine a course of action for each item.

8. The Designer shall revise the design per the direction given in Step 7 (above). The Designer shall then submit a second written response to the DOC IT Review Report, indicating how each comment was resolved.

A. ***Occasionally, DOC workload becomes backlogged and design reviews might not be completed according to the schedule. The Designer shall require DOC to review the documents and respond with written review comments to the Designer at each phase of the design. The Designer shall not proceed with the next phase of telecommunications design without receipt of written comments from the DOC IT Infrastructure Specialist and approval to proceed from the DOC CPD Project Manager***.

B. The Prime Consultant shall be responsible to determine that the review process is conducted in accordance with DOC's requirements, and shall participate in the review process to determine that the review comments are satisfactorily addressed.

3.2.1 RCDD REVIEW CONSULTANT

For projects where DOC hires an RCDD Review Consultant, the prime consultant (Designer or A/E) shall provide two sets of the drawings and specifications (from all disciplines involved in the project) for the RCDD Review Consultant. The RCDD Review Consultant will not perform any design services. The RCDD Review Consultant could be asked to do the following:

3.2.1.1 Typical Document Review Scope

- Review telecommunications distribution system design:
  - For compliance with DOC and Industry standards
  - To identify apparent conflicts (routing, electromagnetic interference, etc.) with other discipline's designs
  - For apparent coordination with telephone service providers or other utilities
  - For general document clarity
- Review the completed needs analysis report.
- Review the cutover plans.

The RCDD Review Consultant shall review the documents according to DOC's requested review scope and then produce a report consistent with the format shown in Appendix 6.1 that addresses at a minimum the following items:

	Components to be Reviewed	Issues to be Considered
Pathways	Horizontal Conduit	Sizing, Sweep Radius
	Horizontal Innerduct	Sizing
	Horizontal Cable Tray	Sizing, Sweep Radius
	Riser Conduit	Sizing, Sweep Radius
	Riser Innerduct	Sizing, Sweep Radius
	Riser Sleeves	Sizing
	Outside Plant Ductbanks	Sizing, Sweep Radius
	Outside Plant Innerduct	Sizing
	Outside Plant Maintenance Holes and Handholes	Sizing, Location
Spaces	Main Equipment Rooms	Racks, Cable Protection and Termination, Grounding & Bonding
	Telecommunications Rooms	Racks, Cable Protection and Termination, Grounding & Bonding
	Riser Shafts	Grounding and Bonding
Cable Plant	Outside Plant	Multi-pair Copper, Fiber Optic, CATV/CCTV Coax
	Horizontal	4-PR UTP Copper, MM Fiber Optic, SM Fiber Optic, CATV/CCTV Coax
	Riser	4-PR UTP Copper, MM Fiber Optic, SM Fiber Optic, CATV/CCTV Coax
	Testing & Administration	Copper, Fiber Optic, Labeling Plan

3.2.1.2 Other Services (upon specific DOC request)

A. On some projects, DOC may also use an RCDD Review Consultant to provide services during the construction phase. These services may include submittal review and "big-picture" construction observation services. In these situations however, the Designer always remains responsible for submittal review, construction observation, punchlist management, and other standard services as indicated in the *Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services* (published by the Washington State Department of General Administration).

B. In these situations, the RCDD Review Consultant shall provide written comments to DOC and to the Designer. In turn, DOC will decide how to act on the written comments, and then direct the A/E, Designer or Contractor accordingly. The RCDD Review Consultant shall not, under any circumstances, give direction to the A/E, Designer or Contractor.

3.3 ARCHITECT/ENGINEER TEAMS

DOC agrees with BICSI that in order to have a building or campus successfully designed, constructed and provisioned for telecommunications, it is imperative that the telecommunications design be incorporated during the preliminary architectural design phase. To accomplish this, the architect shall work closely with the designated project RCDD, the DOC IT Infrastructure Specialist, and the DOC Capital Planning & Development (CPD) Project Manager beginning with the Schematic Design phase of the project.

3.3.1 CROSS DISCIPLINE COORDINATION

DOC agrees with BICSI that successful telecommunications projects require design coordination between the disciplines involved in the project. The Designer shall coordinate the telecommunications requirements and design features with the designs produced by the other designers on the project.

At a minimum, the following aspects of the design shall be coordinated:

3.3.1.1 Outside plant telecommunications infrastructure:

- Ductbank routing around obstacles (trees, tunnels, buildings, existing ductbanks, etc.)
- Coordinate the locations of maintenance holes and hand holes to determine that they are not located in areas of water concentration. Site requirements, drainage, traffic, joint usage, utility requirements, etc.
- Proximity of ductbanks to sources of EMI
- Proximity of ductbanks to steam piping
- Routing of entrance conduits through buildings
- Backbone cabling requirements of other disciplines (fire alarm, HVAC, security, CATV, etc.)

3.3.1.2 Horizontal and Intra-building backbone telecommunications infrastructure:

- HVAC cooling requirements for telecommunications rooms (TR)
- HVAC ductwork routing (avoiding TR ceiling spaces)
- Plumbing routing avoiding TR spaces
- Lighting requirements for TRs
- Power requirements for TRs
- Power requirements for work areas (receptacle locations near telecommunications outlet locations)
- Proximity of cabling to sources of EMI
- Routing of telecommunications conduits through and location of telecommunications pullboxes in congested areas (HVAC ductwork, plumbing, electrical, etc.)
- Floor treatments in TRs

More information regarding the above requirements is available in the Design Criteria section in this document.

3.4 GENERAL PROCEDURES

3.4.1 PROCUREMENT AND INSTALLATION

A. DOC uses several methods for the procurement and installation of the telecommunications infrastructure:
- DIS Master Contract
- Competitive Bid
- Existing DOC Contract
- Strategic Partnerships
- Inter-agency Resource Transfer
- Sole Source (limited use)

B. In larger construction projects, the telecommunications infrastructure installation might be part of the general construction contract or it could be a separate contract. DOC prefers to use the Washington State DIS Master Contract[5] whenever possible to keep costs to a minimum. When the DIS Master Contract is not being used, a competitive bid should be sought, using the contractors listed on the DIS Master Contract website that are approved by DOC. Generally, the procurement and construction of telecommunications infrastructure will be a combined effort between the DOC CPD Project Manager and the DOC IT Infrastructure Specialist.

3.4.2 CAD FILES

The Designer shall coordinate with the A/E to determine that the electronic CAD files used for backgrounds for the telecommunications design are consistent with the CAD file backgrounds used by the other disciplines on the project.

3.4.3 ALTERNATIVE DESIGN REQUEST (ADR)

A. This document identifies specific design solutions that are intended to meet the technical requirements of DOC telecommunications and information technology systems, as well as the unique security requirements necessary at many DOC facilities. Design issues that are not consistent with the requirements in this document shall require prior approval through the DOC Alternative Design Requests (ADR) process. Requests to deviate from industry standards or DOC design solutions will be considered on a case-by-case basis. Any request to deviate from applicable code requirements or to deviate from the requirements of the Avaya SYSTIMAX SCS warranty will not be accepted.

[5] As of this writing, more information about the Washington State DIS Master Contract is available at http://emall.dis.wa.gov/Contracts/MasterContract.asp

B. Requests to apply Alternative Design Requests shall be submitted in writing to the DOC IT Infrastructure Specialist for consideration. The DOC IT Infrastructure Specialist will forward the request, if endorsed, to the Regional IT Manager (ITM) for mandatory DOC review as indicated in the flow chart below. Approval, which will only be granted in writing, shall be authorized by the DOC IT Network Operations Manager (or designee), and (if capital funding is involved) it shall be authorized by the DOC CPD Project Manager.

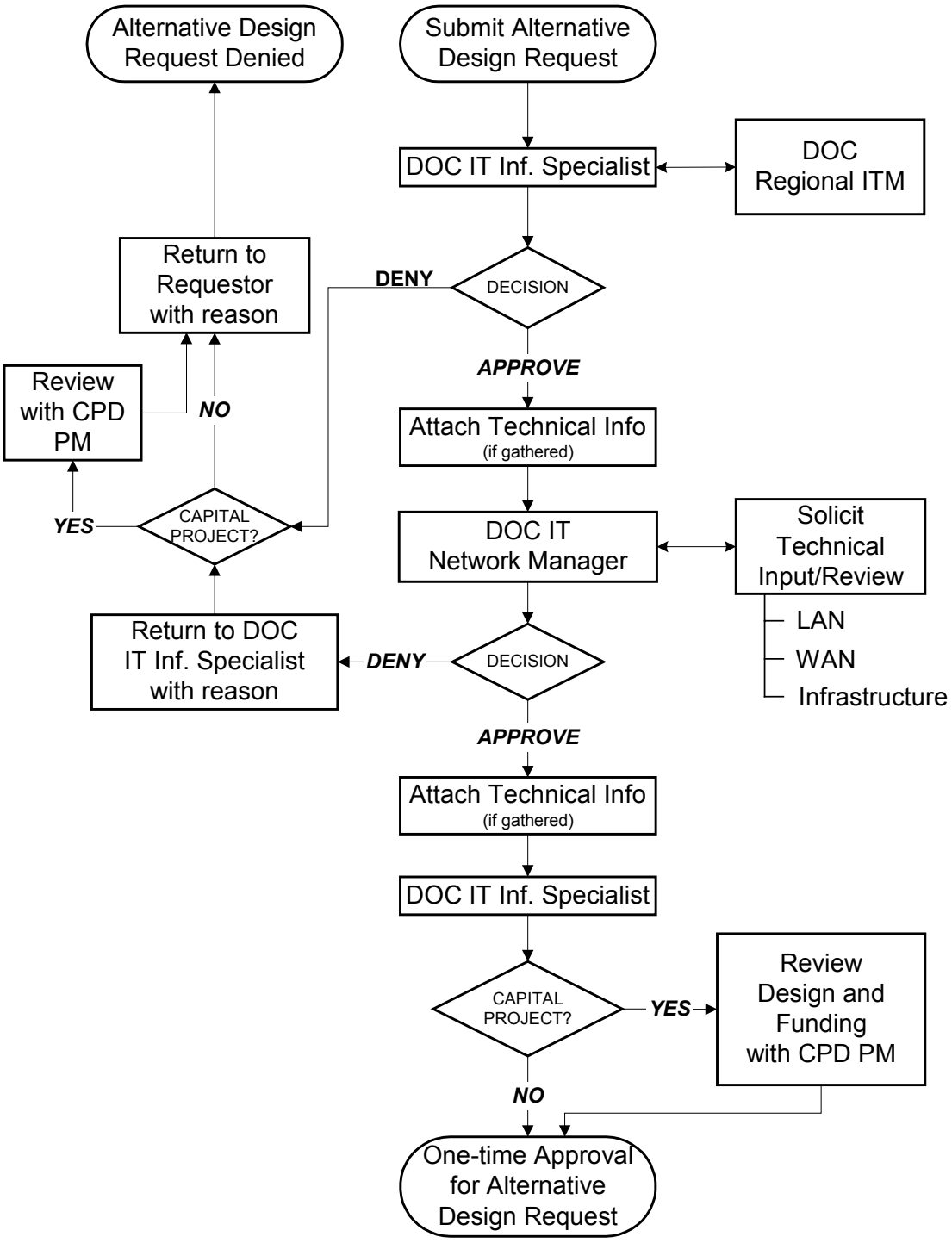
The request shall include a complete description of the proposed alternative design identifying:

1. The type of facility;
2. The conditions at the facility;
3. The approved design solution as described in this document or as described in the standards referenced in this document;
4. The proposed alternative design;
5. A list of the guidelines and standards referenced in this document with which the alternative design will not be in compliance, and the effect of non-compliance, both short and long term;
6. The reason for wishing to use the alternative design;
7. The contractor or personnel performing the construction;
8. A statement identifying the impact to the physical security of the DOC facility. The facility Superintendent, or a senior security officer designated by the Superintendent, must endorse this statement.

C. Finally, the Designer shall provide written comments indicating that the proposed alternative design will meet the applicable DOC system performance requirements, and identifying any performance limitations, drawbacks and benefits from using the alternative design.

D. The Designer shall be responsible to determine that the ADR process is properly conducted. For projects where the Designer is not the prime consultant, the prime consultant shall also be responsible to determine that the ADR process is properly conducted, and shall participate in the process (review, acknowledge and address issues) to determine that DOC's requirements are met.

Approval Process for Alternative Design Requests



3.4.4 PROCEDURES RELATED TO PROJECT PHASES

Telecommunications projects are typically conducted in phases. In addition to the requirements contained in the State of Washington *Conditions of the Agreement* and the *Instructions for Architects and Engineers*, Designers of telecommunications distribution systems for DOC facilities have the following phase-related responsibilities:

3.4.4.1 Schematic Design and Fieldwork

A. Telecommunications projects on existing DOC campuses will require preliminary fieldwork to document the existing cabling and infrastructure systems into which the new cabling and infrastructure will integrate. DOC believes that this information is vital to a successful project.

B. The Designer shall visit the project site during the schematic design phase to perform the preliminary outside plant fieldwork. The Designer shall create the following types of documentation based on information gathered while onsite:
- Take digital photographs of existing telecommunications pathways, spaces and cabling that affect or are affected by the new project work.
- Create butterfly diagrams of each existing maintenance hole and handhole that is associated with the new project, identifying each cable and conduit in each maintenance hole and handhole. A sample butterfly diagram is shown in Appendix 6.2.
- Create a backbone schematic diagram showing the existing outside plant cabling in the area associated with the new project and the existing cross connection strategy. A sample backbone schematic diagram is shown in the Appendix 6.3.

C. The Designer shall visit the project site during the schematic design phase to perform preliminary field investigation of the horizontal and intra-building backbone telecommunications infrastructure. The Designer shall create the following types of documentation based on information gathered while onsite:
- Take digital photographs of existing telecommunications rooms and work areas that affect or are affected by the new project work.
- Create a riser diagram showing the existing intra-building backbone cabling associated with the new project and the existing cross connection strategy.
- Investigate and document the routing of existing horizontal pathways and cabling that is affected by the project.
- Create elevation diagrams of each telecommunications rack and each wall within each TR affected by or affecting the new project work.

D. The Designer shall also conduct a needs analysis (involving DOC personnel) to identify and describe the required features and functionality in the new telecommunications infrastructure.

E. The information gathered during the fieldwork, combined with the results of the needs analysis shall be the starting point for schematic design of the proposed new work.

F. Schematic Design documents shall show the following information:
- Building and local distribution
- Telecommunications Room sizes and locations
- Major distribution pathways
- Backboard locations

G. Upon completion of the Schematic Design documents, the standard Design Review Process shall be conducted prior to progressing to the Design Development phase.

3.4.4.2 Design Development

A. The Designer shall modify the design documents to address the review comments received during the Schematic Design Phase.

B. During the Design Development phase, the Designer shall obtain the assistance of an Avaya product representative to review the project specification (adapted by the Designer from the DOC Telecommunications Construction Guide Specification) to determine that the correct part numbers have been included for each Avaya product in the specification. The Designer shall also verify that the part numbers for non-Avaya products are accurate.

C. In addition to the content shown on the Schematic Design documents, the Design Development documents shall show the following information:
- Schematic diagrams
- Outlet locations

D. Upon completion of the Design Development documents, the standard Design Review Process shall be conducted prior to progressing to the Construction Document phase.

3.4.4.3 Construction Documents

A. The Designer shall modify the design documents to reflect the accepted review comments received during the Design Development Phase. The Construction Documents are also expected to contain the items discussed in the ***Construction Document Content*** section of this document.

B. In addition to the content shown on the Schematic Design and Design Development documents, the Construction Documents shall show the following information:
- Raceway routing plans
- Telecommunications room wall elevation details
- Rack elevation details
- Maintenance Hole/Handhole details

- Ductbank details

C. Upon completion of the Construction Documents, the standard Design Review Process shall be conducted. The Designer shall then modify the documents to reflect the accepted review comments associated with the Construction Documents prior to the Bidding Phase.

D. Upon completion of the Final Construction Documents, the standard Design Review Process shall be conducted as described above. The Designer shall modify the documents to address the review comments associated with the Final Bid Documents prior to the bidding phase rather than "by addendum."

3.4.4.4 Bidding

On projects where a pre-bid walkthrough is held, the Designer shall attend the walkthrough and shall provide the bidders with a written list of materials and practice requirements that the bidders might find peculiar and that might affect the bids if such requirements are overlooked. Noteworthy items would typically be requirements that are more restrictive than practices considered acceptable for other commercial projects. The Designer shall consider the following items for inclusion on such a list, as well as any other items applicable to the project:

- The use of flex-conduit is prohibited.
- The installation of conduit under-slab or in-slab is prohibited.
- The existence of "rat walls"
- The requirement for no more than two 90 degree bends in any conduit run.
- The fact that telecommunications standards are more stringent than electrical installation requirements.

3.4.4.5 Construction Observation

A. The Designer shall review the Contractor's submittals that are required by the Construction Documents. When the Contractor's submittals include materials or methods that deviate from DOC standards, the Designer shall either:
   - Reject the specific materials and methods that do not comply, when the Designer believes that they constitute undesirable solutions.
   - Pursue the ADR process to seek approval for each specific material and method that the Designer believes would constitute a better solution.

B. The Designer (RCDD) shall visit the construction site frequently to observe the construction quality and status. The Designer shall confer with the DOC Project Manager prior to proposing services for the project to determine an appropriate site-visit frequency for the project. On average, one site visit per week will typically be required for building-wide projects and one and a half site visits per week will be typically required for campus-wide projects. The frequency will likely change during the construction as the telecommunications-related activity increases and decreases.

C. During the site visits, the Designer shall take digital photographs of existing and

new telecommunications pathways, spaces and cabling, both intra-building and outside plant and that are related to the project. In particular, the Designer shall photograph infrastructure that will later be concealed during the course of construction.

D. Accurate record drawings are considered critical for the efficient operation of DOC facilities. During these site visits, the Designer shall observe and report on the Contractor's progress toward staying current with the record drawings notations.

E. After each site visit, the Designer shall submit a written report describing the observed construction progress. Observations shall be documented in the report with annotated digital photographs and a written description of any problems, a description of the requirements in the Construction Documents and the resolution to the issues. For each item requiring corrective attention, the report shall describe the following:

Description of the issue:	
Applicable Requirements in the Construction Documents:	
Applicable DOC standards, industry standards and codes:	
Corrective options available to DOC:	
A	
B	
C	
Designer's Recommendation:	

F. The Designer shall submit the construction observation reports via email to the DOC CPD PM and the DOC IT Infrastructure Specialist as soon as possible following each site visit. The reports shall also be reviewed at the next construction meeting. A timely report submission will aid the Designer and DOC in identifying potential problems early in the construction process.

G. The Designer shall review the cable test reports produced by the Contractor for each cable installed during the project. The Designer shall verify that the following conditions are addressed in the cable test reports:

For Fiber Optic Cabling	For UTP Cabling
The cable test report shall be automatically produced by the test equipment.	The cable test report shall be automatically produced by the test equipment.
The report shall indicate that the cable passed the test.	The report shall indicate that the cable passed the test.
The Designer shall verify that the cable test report indicates a headroom dB value that is equal to or better than the value calculated in the link-loss budget.	The Designer shall verify that the cable test report indicates the correct Nominal Velocity of Propagation (NVP) indicated on the cut sheet from the cable manufacturer.

3.4.4.6 Post-Construction

A. The Designer shall review the Operation and Maintenance information provided by the Contractor for the telecommunications distribution system. The Designer shall verify that information is included for each component in the telecommunications distribution system. Upon approval of the content in the Operation and Maintenance information, the Designer shall submit the information to local DOC IT Staff with written documentation indicating that the Designer has reviewed the information and that it appears to meet the requirements in the Construction Documents.

B. The Designer shall provide record drawings and record documentation to DOC (based on documents that have been "red-lined" by the Contractor).

4 DESIGN CRITERIA

A. The DOC TDDG is not intended to be a comprehensive design guide resource for telecommunications design at DOC facilities. The Designer shall look primarily to the BICSI TDMM and CO-OSP for design guidance. The resulting Construction Documents shall also be consistent with the installation practices described in the BICSI Telecommunications Cabling Installation Manual (TCIM).

B. Where ANSI/TIA/EIA Standards or BICSI manuals offer multiple choices with a preferred method identified, and where the DOC TDDG does not select one method over another or define specific requirements precluding use of the preferred method, the ANSI/TIA/EIA or BICSI-preferred method should be selected.

C. Where ANSI/TIA/EIA Standards or BICSI manuals identify warnings regarding potential adverse effects from certain design or installation methods, the design or installation method used should typically be the method with the least potential for adverse effects.

D. Telecommunications distribution systems shall be designed for construction using materials from the current Avaya SYSTIMAX Structured Connectivity Solutions (SCS) product line. The design documents shall require that the workmanship fully comply with the current Avaya SYSTIMAX SCS installation guidelines and performance specifications.

E. Any request to deviate from the requirements of the National Electrical Code or the Avaya SYSTIMAX SCS warranty will not be accepted. The Designer shall seek approval for designs that are not consistent with DOC TDDG requirements through the DOC Alternative Design Request (ADR) process. Requests to deviate from industry standards or DOC design solutions will be considered on a case-by-case basis by the DOC IT Infrastructure Specialist. Designers are encouraged to contact the DOC IT Infrastructure Specialist to discuss proposed alternatives before spending any significant time on an alternative.

F. Telecommunications distribution infrastructure shall fully comply with the current DOC TDDG, the current Washington State Department of Information Services (DIS) "Computing and Telecommunications Architecture Standards – Building Wiring", the current ANSI/TIA/EIA Commercial Building Telecommunications Standards and the National Electrical Code (NEC).

G. The following subsections are arranged to mirror the chapter sequence of the BICSI TDMM (the subsection numbers below are in the form of 4.x where x represents the chapter number in the BICSI TDMM).
   - Each TDDG subsection contains commentary and requirements regarding the application of the BICSI TDMM to DOC Projects. In particular, each section contains limitations and prohibitions on specific materials and methods discussed in the BICSI TDMM.

- Where no TDDG subsection is written (addressing comments about or requirements for the corresponding TDMM subchapter) the Designer can assume that the TDMM subchapter applies as written.

4.1 GENERAL INFORMATION

The *General Information* section of the BICSI TDMM is not applicable to this document.

4.2 CODES, STANDARDS AND REGULATIONS

Please refer to the *Codes, Standards and Regulations* section of the BICSI TDMM for information regarding the codes, standards and regulations required for telecommunications infrastructure at DOC facilities.

4.3 DEFINITIONS, ABBREVIATIONS, ACRONYMS & SYMBOLS

Please refer to the *Definitions, Abbreviations, Acronyms, and Symbols* section of the BICSI TDMM for definitions, abbreviations, acronyms and symbols used for describing and documenting telecommunications infrastructure at DOC facilities.

Other terms are defined in the Glossary located in Appendix 6.7 of this document.

4.4 HORIZONTAL DISTRIBUTION SYSTEMS

Please refer to the *Horizontal Distribution Systems* section of the BICSI TDMM for general information regarding the design of horizontal distribution pathway and cabling. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

4.4.1 HORIZONTAL PATHWAY SYSTEMS

The design and installation practices for intra-building telecommunications conduit have some unique requirements beyond those normally applicable to standard electrical conduit. The following items are required to be included in the design and installation of intra-building telecommunications conduit in DOC facilities:

- For the main floor in, "slab on grade constructed buildings", conduit will route in walls and ceilings not in or under the slab.

4.4.1.1 Sizing Considerations for Horizontal Pathways

A. The cable pathway shall be sized to support the initial installation of cable, plus a minimum of 25% growth.

B. During the Schematic Design phase, the Designer shall discuss with DOC the future growth anticipated for the facilities affected by the project and increase accordingly the spare capacity to be designed.

C. Conduit runs shall be designed with larger feeder conduits that transition to multiple smaller distribution conduits at strategically located junction boxes.

4.4.1.2 Design Considerations for Conduit Distribution

A. Conduit runs shall not be designed using "multi-drop" or "daisy-chain" configurations.

B. Where conduit runs terminate in telecommunications rooms, the conduits shall be arranged in an organized manner to facilitate an orderly cable transition from conduit to backboard.

C. Surface metal raceways and surface non-metallic raceways (e.g. Panduit, Wiremold) shall not be used in new construction.

D. DOC does not permit the use of any non-metallic conduit for horizontal pathways.

4.4.1.3 Conduit Capacity

A. Conduits shall not be filled with multiple cables beyond 40%. The Designer shall refer to the BICSI TDMM (Chapter 4) for information regarding conduit capacity and fill. The Designer shall verify the outer diameter of all cable approved for use by DOC at the time of the design to determine the maximum number of cables that can be placed inside a conduit without exceeding the 40% fill limitation. The following table shows the quantity of cables that can be placed in a single EMT conduit, based on the typical current dimensions of two Category 3 and four specific Category 6 horizontal cables from Avaya:

EMT Raceway		Avaya Cables, OD (in.)					
		1010-4PR	2010-4PR	1071C	2071A	1081	2081
Trade		0.184	0.184	0.235	0.215	0.250	0.240
Size	I.D. (in.)	Max # of Cables per Conduit (@ 40% fill)					
1"	1.049	13	13	7	9	7	7
1 1/4"	1.380	22	22	13	16	12	13
1 1/2"	1.610	30	30	18	22	16	18
2"	2.067	50	50	30	36	27	29
2 1/2"	2.731	88	88	54	64	47	51
3"	3.356	133	133	81	97	72	78
3 1/2"	3.834	173	173	106	127	94	102
4"	4.334	221	221	136	162	120	130

B. In new construction, all wall outlets shall have a minimum one-inch trade size conduit routing from the device box to an accessible cable pulling location. Increase the conduit size as necessary for the quantity of cables to be installed. Where new conduit is installed in existing buildings, the Designer shall notify DOC when existing conditions prevent the use of one-inch trade size conduit as a minimum conduit size.

4.4.1.4 Multidrop Conduit Systems

DOC does not permit the use of the Multidrop Conduit System as identified in the BICSI TDMM.

4.4.1.5 Pull Boxes (PBs) for Conduits

A. Pull boxes shall be designed for access doors to open from the area where the cable installer will normally work. This is typically from the bottom (floor) side of the box.

B. Ceiling access to the pull box shall be designed to allow full access to the pull box door and adequate working room for both the installation personnel and proper looping of the cable during installation. In hard-lid ceilings, the access cover (or pull box door if exposed) shall be lockable in a secured area.

4.4.1.6 Access Floors

DOC design typically places telecommunications cables above equipment racks on cable runways and runs electrical cables in the access floor space. If both are in the access floor space, DOC requires electrical power circuits to be placed in rigid steel conduit and maintain adequate separation (according to the *Electromagnetic Compatibility* subsection of this document) to avoid EMI.

4.4.1.7 Ceiling Distribution Systems

A. When considering the possibility of designing a non-conduit ceiling distribution system in DOC facilities, the Designer shall verify that the locations under consideration will comply with the space, accessibility and clearance requirements identified in the ANSI/TIA/EIA Standards and the TDMM. Ceiling distribution systems shall be designed such that all installed cable is conveniently accessible after construction for both cable maintenance and to install subsequent cable additions.

B. Conduit shall be used to route cabling across "hard-lid" ceilings, where ceiling tiles are not readily removable, or where accessibility is less than recommended.

4.4.1.8 Cable Tray Design for Ceiling Systems

Cable trays shall not be shared with power cables and shall maintain the minimum separation distances required by DOC. Each cable tray section shall be bonded.

4.4.1.9 Distribution from Ceiling Systems – Utility Columns

DOC requires that utility columns used for both telecommunications and power distribution be metallic and be equipped with a metallic barrier.

4.4.1.10 Poke-Thru

Poke-thru distribution is not acceptable in DOC-owned facilities

4.4.1.11 Wet Locations

A. Wet locations include areas such as slab-on-grade construction, where pathways are installed underslab or in concrete slabs that are in direct contact with soil (e.g.,

sand, gravel, etc.).
- For the main floor in, "slab on grade constructed buildings" conduit will route in walls and ceilings, not in or under the slab.

B. Intra-building and horizontal pathways shall only be installed in "dry" locations where indoor cabling can be protected from humidity levels that are beyond the intended humidity range for use of indoor-only rated cable.
- Alternative Design Requests to route pathways through wet areas will not be accepted.

4.4.1.12 Non-secured Areas

Intra-building telecommunications pathway in non-secured areas shall be designed consistent with industry codes, standards, and the guidelines in the BICSI TDMM. The pathway method selected shall be appropriate for the type of facility. For example:
1. Surface mounted conduit or tubing might be used in a warehouse or a utility building.
2. When retrofitting an existing office, distribution above a false ceiling or an aesthetically pleasing surface mounted raceway might be used.
3. For new construction, conduit shall be provided concealed in walls and ceilings wherever possible.

4.4.1.13 Secured Areas

The following requirements apply to intra-building telecommunications pathway within secured areas:
1. All telecommunications cabling within a secured area shall be completely enclosed in a metallic conduit system. Non-metallic conduit shall not be used.
2. The conduit system shall be concealed inside ceilings and walls to the greatest extent possible. Surface mounted conduit will be permitted only when there is no other route to provide service to the desired location.

4.4.1.14 Correctional Industries.

A. The telecommunications substructure supporting Correctional Industries (CI) locations shall be designed and installed to provide maximum flexibility to meet the needs of the private companies who operate in CI locations as tenants.

B. The horizontal telecommunications pathway supporting Correctional Industries (CI) locations shall be designed and installed to provide maximum flexibility. CI locations are frequently "warehouse" style buildings and are usually inside the secured area. The Designer shall apply the following guidelines when planning the horizontal telecommunications pathways for CI locations:
   1. DOC Policy 280.925 "Offender Access To Electronic Data" governs the use of Information Technology by offenders at DOC locations. Additionally, DOC IT has written a draft Guideline covering cable installation and network connections for vendors and contractors doing business with Correctional Industries at DOC locations. The Designer shall review all telecommunications infrastructure designs for Correctional Industries with the DOC IT Infrastructure

Specialist to insure full compliance with the requirements of the DOC policy and IT guideline. The final design shall be approved by the local Superintendent or designee.

2. The Designer shall include horizontal pathway to and within CI locations in the design documents. The Designer shall request direction from DOC regarding the requirements for telecommunications infrastructure serving CI locations on a case-by-case basis.
3. All low voltage infrastructure installed for CI and their vendors shall be in full compliance with the DOC TDDG.
4. Telecommunications infrastructure in CI locations shall be sized to allow a minimum of 25% growth.
5. All cabling shall be completely contained in an enclosed conduit system. All telecommunications distribution equipment shall be in a lockable telecommunications room or lockable steel telecommunications cabinet.
6. TRs serving CI locations shall be provided with additional vacant egress pathways (such as sleeves) to accommodate future changes to the telecommunications cabling due to the higher rates of tenant turnover expected in these locations.

4.4.2 HORIZONTAL CABLING SYSTEMS

4.4.2.1 General

A. The Designer shall work with DOC program staff and IT staff (both at the project facility and at DOC headquarters) to identify and understand the needs and requirements for each facility on a project-by-project basis. This includes understanding the expected future uses of each facility. The Designer shall design the telecommunications infrastructure accordingly.
   - DOC has standardized on the Avaya SYSTIMAX® Structured Cabling System product line for telecommunications infrastructure. Therefore, telecommunications infrastructure designs and specifications shall be based upon the Avaya SYSTIMAX® Structured Cabling System.

B. For the purposes of this document, references to Category 6 cable in this document shall be interpreted as Avaya SYSTIMAX® GigaSPEED cable. The Designer shall check with the DOC IT Infrastructure Specialist to determine the AVAYA SYSTIMAX cable products that shall be used for the project.

C. The basic configuration for providing telecommunications infrastructure for a work area is to provide a minimum of one 4-pair cable for voice and one 4-pair cable for data. There are many situations that require more or less cables than the basic configuration, for example:
   - A wall mounted telephone location might need only one voice cable.
   - A particular work area might require one data and two voice cables to support a computer, telephone, and fax machine.
   - Additional data cables shall be provided to accommodate LAN-attached printers or other devices.

D. Providing spare ports for an outlet in a work area and providing spare outlets in a room are encouraged within the limitations of the project budget to meet projected future needs.

E. Generally, the eight-position pin/pair assignment for new cabling in new construction shall be the T568B configuration. The T568A configuration shall only be used in the following two cases (but only after receiving written approval from the DOC IT Infrastructure Specialist):
1. For new cabling in a new building on an existing site, when the T568B configuration does not exist anywhere on the campus.
2. For new cabling added to existing cabling in an existing building, where the existing cabling is to remain in operation and where the T568B configuration does not exist anywhere in that building.

In all other cases, new cabling shall be terminated using the T568B configuration.

F. Outdoor-rated waterproof cable will not be allowed in horizontal cabling applications.

4.4.2.2 Horizontal Cable to Support Data Applications

A. At DOC facilities, horizontal distribution copper cable and components for data applications shall be rated and installed to support the IEEE 802.3ab 1000Base-T Gigabit standard.

B. Horizontal distribution cable to support data applications (and all other low voltage systems that are capable of operating with 24 AWG copper cabling) shall be Avaya SYSTIMAX® GigaSPEED 4-pair Category 6 cable in new installations.
1. Category 6 GigaSPEED cables shall be terminated at the work area end with Avaya GigaSPEED information outlets. The outlets shall be colored yellow unless the facility has a different pre-established color code for Category 6 outlets. In all cases, Category 6 outlets shall be of a color that is different from other outlet categories.
2. Category 6 GigaSPEED data cables shall be terminated at the telecommunications room end with Avaya PATCHMAX GigaSPEED distribution hardware.

C. In existing buildings, where additions are made to an existing Category 5 or 5e installation, the additions shall be made using Avaya SYSTIMAX® Category 6 cable and matching components. The Category 6 cable sheath shall be of a color that is different from other existing cable that is less than Category 6.
1. Category 5 cable and components shall not be purchased or installed.
2. Existing DOC inventories of Category 5e cable and components may be used until it is depleted. Additional Category 5e cable and components may only be purchased following approval through an Alternative Design Request.
3. Category 6 cables shall be terminated at the work area end with an AVAYA GigaSPEED information outlet. The outlet shall be colored yellow unless the facility has a different pre-established color code for Category 6 outlets. In all cases, Category 6 outlets shall be colored differently from other outlet

categories.

4. Where only two or three new cables are required, Category 6 GigaSPEED cables may be terminated at the TR end on existing Category 5 patch panels or existing model 1100PSCAT5e Modular Patch Panels if those patch panels have existing ports available for the new cabling.
5. Where more than three new cables are required or where there is insufficient existing port availability on existing Category 5 or 5e patch panels, the DOC IT Infrastructure Specialist shall be contacted for specific direction on a case-by-case basis.
6. All newly purchased patch panels shall be Category 6 AVAYA GigaSPEED PATCHMAX.

D. **Under no circumstances will the splitting of data cable pairs be allowed** on either side of the information outlet or either side of the outlet panel or patch panel.
- External line splitting devices shall not be used.

4.4.2.3 Horizontal Cable to Support Administrative Voice Applications

A. Horizontal distribution cable intended to support voice services in new installations or major renovations shall be the same Avaya SYSTIMAX® GigaSPEED 4-pair Category 6 cable that is used for data applications.
1. Category 6 GigaSPEED voice cables shall be terminated on 110 wiring blocks, located in the same rack as the Category 6 data patch panels, or in an adjacent rack. A tie-cable (25 pair minimum) shall be installed from the rack to the backboard to support connections to backboard-mounted devices.
2. Acceptable alternatives to the 110 wiring block are the AVAYA 110 VisiPatch system or Category 6 workstation patch panels.
3. The Designer shall review the type of termination equipment as well as the layout and design of equipment racks with the DOC IT staff assigned to the facility and also with the DOC IT Infrastructure Specialist.

B. Additions of horizontal distribution cable to support voice services in existing buildings with CAT 3 shall be Avaya SYSTIMAX® 4-pair Category 3 cable, or a SYSTIMAX® approved substitute of equivalent or better performance.
1. Category 3 horizontal distribution voice cables shall be terminated at the backboard in the Telecommunications Room on Avaya SYSTIMAX® 110 Wiring Blocks using 110C-4 Connecting Blocks.
2. Category 3 horizontal distribution voice cables shall be terminated at the work area end into ivory colored Avaya SYSTIMAX® type M1BH/1 Modular 8-position, eight 8-conductor information outlets.

C. **Under no circumstances will splitting of voice cable pairs be allowed**. To support an additional telephone at a work area on existing cable, install an external line-splitting device on the outside of the information outlet faceplate and connect the additional cross-connect wires to the appropriate pins on the connecting blocks in the TR. Splitting of wire pairs degrades the performance of both the split pairs and voids the AVAYA SYSTIMAX warranty.

4.4.2.4 Horizontal Cable to Support Inmate Voice Applications

Horizontal distribution cable to support inmate telephones shall be Avaya SYSTIMAX® 4-pair Category 3 cable. Higher pair count cables may be used to serve banks of telephones, as appropriate. In new installations, and wherever possible at existing facilities, cables supporting inmate telephone service shall be separate cables (separate sheaths) from cables supporting other telephone or data services in the facility.

1. Category 3 horizontal distribution cables for inmate telephone service shall be terminated at the TR on 110 Wiring Blocks that are physically separated from the 110-blocks used for prison administration telephone wiring. The Designer shall confer with local DOC Intelligence & Investigations (I&I) staff to determine whether the circumstances in the local Inmate Telephone Equipment Room (ITER) will require that the 110 blocks and BEPs be enclosed in lockable cabinets.
2. The work area (telephone) end of inmate telephone cables shall not be terminated by the cable installer. The inmate telephone service provider will terminate these cables directly into the telephone sets. If any modular information outlets are used for Inmate Telephone terminations, they shall be colored green.
3. The Designer shall coordinate with the DOC facility security representative to identify locations for inmate telephones and mounting structures for each location.

4.4.2.5 Patch Cords

A. Patch cords shall be Avaya SYSTIMAX® factory manufactured patch cords. Patch cords shall be certified by the manufacturer to match the cable type used in the horizontal distribution.
   1. Category 3 horizontal cable shall use a Category 3 or better patch cord.
   2. Category 6 GigaSPEED patch cords shall be used with all other horizontal cabling, regardless of "category".
   3. Field terminated patch cords are not acceptable. Any existing field-assembled patch cords used in areas affected by a project shall be replaced under the project with factory assembled Category 6 patch cords.

B. In new installations where Category 6 cables are used for both voice and data service, Avaya SYSTIMAX® factory manufactured 110 patch cords shall be used when a voice outlet is used for data. These patch cords shall be 24-AWG stranded copper, with a 110 plug on one end, and an 8-position 8-conductor modular plug (RJ-45 type) on the other end.

C. Where the AVAYA Visi-PATCH system is installed, only AVAYA SYSTIMAX factory-manufactured 110 Visi-PATCH patch cords shall be used. Patch cords with less than 4-pairs of wire are available from AVAYA.

4.4.2.6 Horizontal Cabling to Support Correctional Industries

The telecommunications infrastructure supporting Correctional Industries (CI) locations shall be designed and installed to provide maximum flexibility. The following requirements shall be followed when planning the telecommunications cabling for CI locations:

1. The Designer shall include voice and data cabling to and within CI locations in the

design documents. The Designer shall request direction from DOC regarding the requirements for telecommunications infrastructure serving CI locations on a case-by-case basis.

2. All cabling shall be completely contained in an enclosed metallic conduit system.

4.4.2.7 Horizontal Cable to Support Low Voltage and Building Automation Systems

A. During planning for intra-building telecommunications cabling installations, the Designer shall identify options for supporting power limited (low voltage) and building automation systems with the common structured cabling system, and present the options to DOC for consideration.

B. By providing a common cabling distribution system for the various building automation systems, it may be possible to reduce construction costs and operational costs while creating an intelligent building that can contribute many other benefits (see TDMM Chapter 21 for further information). Low voltage systems that are capable of using a common structured cabling system (either backbone or horizontal cabling) shall be designed to use the Avaya SYSTIMAX® Structured Cabling System cable and termination hardware wherever possible.

C. The Designer shall request from DOC a list of systems that will require telecommunications outlets for operations. The Designer shall then include outlets in the design as necessary to meet the listed requirements.

4.4.2.8 Horizontal Cable Slack

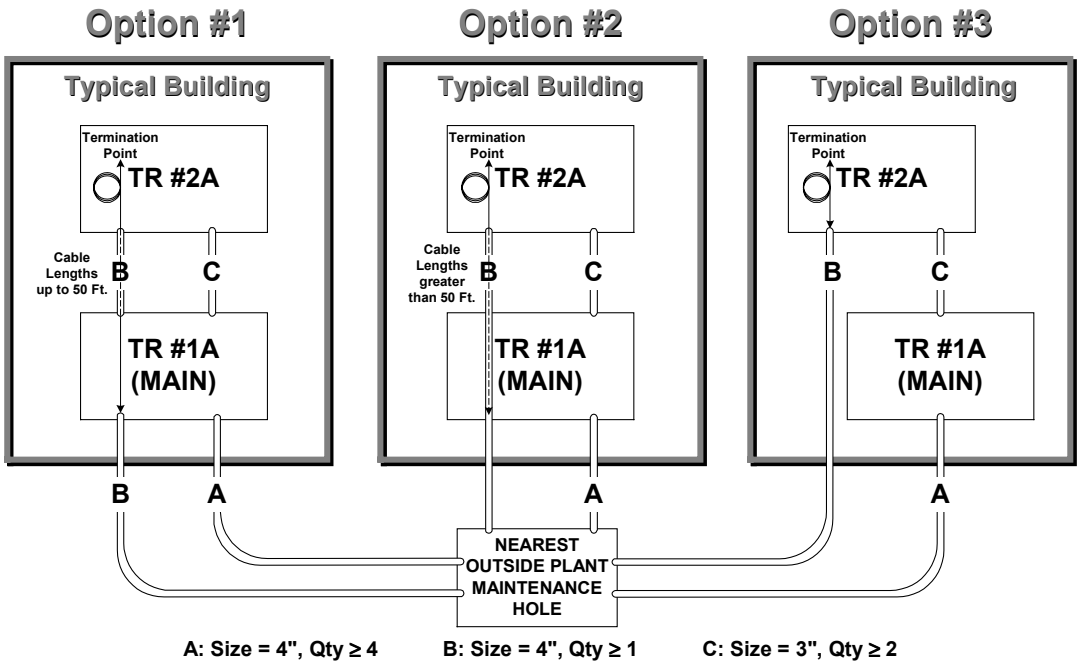
Cable slack shall be provided at both ends of all horizontal cable installations per the recommended minimum amount in the BICSI TDMM.

4.5 BACKBONE DISTRIBUTION SYSTEM

Please refer to the *Backbone Distribution System* section of the BICSI TDMM, the *Pathways and Spaces* section and the *Cabling* section of the BICSI CO-OSP, and the *Installing Backbone Pathways* section of the BICSI TCIM for general information regarding the design of backbone distribution pathway and cabling. The following requirements take precedence over the BICSI TDMM, the BICSI CO-OSP, and the BICSI TCIM guidelines for telecommunications infrastructure at DOC facilities:

4.5.1 INTRA-BUILDING BACKBONE PATHWAYS

The diagram below shows three options for routing entrance pathways between the outside plant maintenance holes and each telecommunications room in a building as well as routing intra-building backbone pathways. Please note that while intermediate pull boxes are not shown in the diagram below, they may be required in some applications per BICSI TDMM requirements.



Option #1 applies when the following two conditions both exist:

- When the most desirable route (between the nearest outside plant telecommunications maintenance hole and a secondary TR) is to pass through the main TR to reach a secondary TR.
- When the cable length (including 25 ft. service loops) is 50 feet or less from the point that it enters the main telecommunications room to the point where it terminates in the secondary telecommunications room.

Please note that the cabling in conduit "B" passes through the Main TR without terminating or being spliced. While it is permitted for the cable in the Main TR to exist the conduit on one wall and re-enter conduit on another wall, the only termination for the cable is in TR #2A.

Option #2 applies when the following two conditions both exist:

- When the most desirable route (between the nearest outside plant telecommunications maintenance hole and a secondary TR) is to pass through the main TR to reach a secondary TR.
- When the cable length is more than 50 feet from the point that it enters the main telecommunications room to the point where it terminates in the secondary telecommunications room (including 25 ft. service loops).

Please note that the cable remains inside conduit "B" while it passes through the Main TR without terminating or being spliced. The cable then terminates in TR #2A.

Option #3 applies when the most desirable route (between the nearest outside plant telecommunications maintenance hole and a secondary TR) does **not** pass through the main TR to reach a secondary TR.

A. DOC requires a quantity of four trade size 4″ entrance conduits connecting the main TR in each building with the nearest OSP telecommunications maintenance hole or handhole. (See the conduits labeled "A" in the diagram above, representing four or more conduits routed between the Main Telecommunication Room in the building to the nearest outside plant telecommunications maintenance hole or handhole.) One of the four conduits shall be fitted with a full set of fiber optic innerducts (three 1 ¼″ innerducts). The Designer shall recommend (via the Alternative Design Request process) a smaller quantity of entrance conduits for smaller buildings where four conduits might not be economically justifiable.

B. Any secondary TRs in a building shall be provided with at least one trade size 4″ conduit that runs from the nearest OSP telecommunications maintenance hole or handhole. (See the conduits labeled "B" in the diagram above, each representing one or more conduits routed between a secondary Telecommunication Room in the building and the nearest outside plant telecommunications maintenance hole or handhole.) This conduit shall be fitted with a full set of fiber optic innerducts (three 1 ¼″ innerducts). If more than one conduit is provided here, the others do not necessarily need to be fitted with innerduct if they will initially be empty.

C. The design shall provide for sufficient quantities of trade size 4″ conduit to accommodate the low voltage services planned for initial installation plus a minimum of either 25% growth capacity or one spare conduit (whichever is larger).

D. Any secondary TRs in a building shall also be provided with at least two trade size 3″ conduits. (See the conduits labeled "C" in the diagram above, each representing two or more conduits routed between the Main Telecommunication Room in the building and another TR in the same building.)

4.5.2 INTRA-BUILDING BACKBONE CABLING

A. DOC requires that each TR in each building be provided with non-spliced fiber optic backbone cabling that is directly connected to the Main Equipment Room at the site via the outside plant pathway infrastructure.

B. Generally, the OSP copper backbone cables from the Main Equipment Room at the site will terminate in the main TR of a building. Copper backbone cabling for voice applications should then be routed from the main TR in a given building to the other TRs in that building.

C. For new construction, intra-building backbone cabling shall be grouped together in one of the intra-building backbone conduits, leaving the other conduit(s) vacant for future use.

4.5.3 INTER-BUILDING (CAMPUS) BACKBONE PATHWAYS

4.5.3.1 Ductbank

A. The telecommunications distribution pathway system shall accommodate the requirements for signal and low voltage cabling systems at DOC facilities. The pathway system shall be designed such that telecommunications and other low voltage systems do not share conduits, maintenance holes, handholes or tunnels with the electrical power distribution system. The telecommunications distribution pathway shall also maintain the minimum separation distance from the electrical power distribution system as required by DOC. The Designer shall inquire with both the local and Headquarters DOC staff about the potential for future buildings or building expansions that may adversely affect an existing or proposed distribution pathway and accommodate those plans within the design.

B. DOC requires 4″ trade-size Schedule 40 PVC for all outside plant pathway, with the exception of the transition to PVC-coated rigid steel (discussed below). Multiple-cell conduit shall not be used. Campus distribution conduits shall be buried a minimum of 30 inches deep. Where this minimum depth cannot be achieved due to physical constraints, approval for burial at an alternative depth may be requested through the ADR process.

C. Where the conduit is placed beneath vehicular traffic (i.e., drives, roadways, etc.) or where a bend or sweep is placed in the conduit system, OSP conduit shall be encased in concrete with a minimum compressive strength of 2500 psi. Prior to the concrete being poured, a DOC field representative (designated by the DOC IT Infrastructure Specialist) shall observe the OSP conduit installation to identify unacceptable installations.

D. Conduit to be used for routing entrance cables from the service providers to the Entrance Facility shall be installed per the service providers' requirements, generally 36 to 48 inches deep. The Designer shall consult with the service providers prior to designing conduits serving the Entrance Facility.

E. OSP conduit shall transition from PVC to PVC-coated, rigid steel conduit when it enters a 10-foot zone of circumference around the building foundation and shall route from that point to the building Entrance Facility. PVC-coated, rigid steel conduit is intended to provide protection from the shearing effect of excavated ground settling around the building foundation. It also provides protection from future landscaping activities near the building.

F. The use of flexible metallic conduit and flexible non-metallic conduit is prohibited.

4.5.3.2 Maintenance Holes and Handholes

A. Splices in backbone fiber optic cable are not allowed, and while splices in backbone copper cable may be permitted in some cases (through an approved ADR), they are not encouraged. However, when sizing OSP telecommunications

maintenance holes and handholes, the design shall provide space for possible future fiber splicing when required (for example, to repair cable breaks when and if possible).

B. Telecommunications maintenance holes or handholes shall be placed in outside plant conduit runs at an interval no greater than every 600 feet. The following rules apply to maintenance hole/handhole design:
- A conduit exiting a maintenance hole or handhole shall be aligned opposite the wall and at the same elevation where it entered the maintenance hole or handhole.

C. Maintenance holes or handholes placed inside secured areas shall have lockable or bolt down covers to prevent unauthorized access and shall require the approval of the local DOC Captain or head of security.
- Handholes shall not be used as a cable splice point or for a ductbank containing more than 3 conduits.

4.5.3.3 Aerial Distribution

Aerial distribution of telecommunications cabling at DOC facilities is not authorized unless specific approval is granted through the "Alternative Design Request" process. In cases where aerial distribution is approved for use, the facility Superintendent or designated representative shall determine that the use of aerial distribution presents no significant risk to physical security at the facility. The Designer shall review construction of aerial distribution systems for compliance with the design. The design and installation shall also be reviewed, approved, and inspected by the DOC IT Infrastructure Specialist or designee.

4.5.3.4 Bridge and Waterway Crossings

The Designer shall review the construction of bridge and waterway crossing distribution systems for compliance with the design. The design and installation shall also be reviewed, approved, and inspected by the DOC IT Infrastructure Specialist or designee.

4.5.3.5 Wireless and Radio System Distribution

A. DOC facilities frequently use wireless or radio systems for communications with mobile units and personnel, both on and off of the campus. These systems typically use one or more radio antennas connected by cabling to radio transceiver equipment. In many cases, the radio equipment is interfaced into the telephone system. The outside plant telecommunications substructure shall provide adequate cable routing pathways between antenna locations, radio transceiver locations, and the telephone backbone cabling system.

B. Radio antenna transmission cables that connect the antenna to the radio transceiver emit radio frequency (RF) radiation. These cables may be routed through the common telecommunications duct bank and maintenance hole system if necessary, but shall be routed in a separate conduit from other telecommunications cables. Cables containing RF radiation shall be shielded cables.

C. Radio interconnection cables (for analog or digital signaling to remote radio operating positions or to the telephone system) typically emit low levels of radio frequency radiation. These interconnection cables shall be routed through the common telecommunications duct bank and maintenance hole system. Individual conduits may be shared for these interconnection cables and other telecommunications services, and available cable pairs in telephone backbone cables may be used for these interconnections, provided that the signaling is analog or digital signaling, and is not direct radio frequency signal.

4.5.4 CAMPUS CABLING

4.5.4.1 General

A. As discussed in the *Preface* section of this document, telecommunications distribution systems designed for DOC facilities are expected to support and integrate all low voltage, power limited signal systems and Building Automation Systems that convey information within and between buildings wherever practicable.
   - During planning of backbone cable installations, the opportunity for these systems to use the common structured cabling system shall be evaluated by the Designer and discussed with DOC. The backbone cabling design shall reflect the needs and requirements identified during these discussions.

B. OSP cable shall be installed in the lowest available conduit in a duct bank, working up as additional cables are installed.

C. **The use of direct buried cabling is prohibited**.

4.5.4.2 Copper Backbone Cabling

A. DOC requires that copper backbone cabling be designed and installed in an unspliced, home-run configuration.

B. Twisted-pair copper cabling shall not be used for interbuilding data backbone applications.

C. Pressurized cabling and associated pressurization systems shall not be used at DOC facilities. Where such cabling exists, the Designer shall notify DOC and evaluate the costs and benefits of replacing it.

D. Outside plant voice backbone cabling shall be Category 3 copper twisted pair cabling.

4.5.4.2.1 Administrative Voice Backbone Cabling

Administrative voice backbone cables (all voice backbone cabling that is not intended for inmate voice applications) shall meet the following requirements:

1. Voice backbone cables shall be sized to support two pairs per work area outlet, plus

25% growth. When calculating size, work area shall also include fax machines and dial-up modems.
2. Inter-building voice backbone cables shall be terminated with a primary protector panel at each cable end. The protector panel shall be equipped with 4B-EW Series Protector Units that provides sneak-current protection.
3. Voice backbone cables shall be terminated to wall-mounted SYSTIMAX® 110 Wiring Blocks, using 110C-5 Connecting Blocks.

4.5.4.2.2 Inmate Voice Backbone Cabling

Backbone cabling to support inmate telephone service shall meet all of the same requirements for administration voice backbone cables above, plus the following additional requirements:

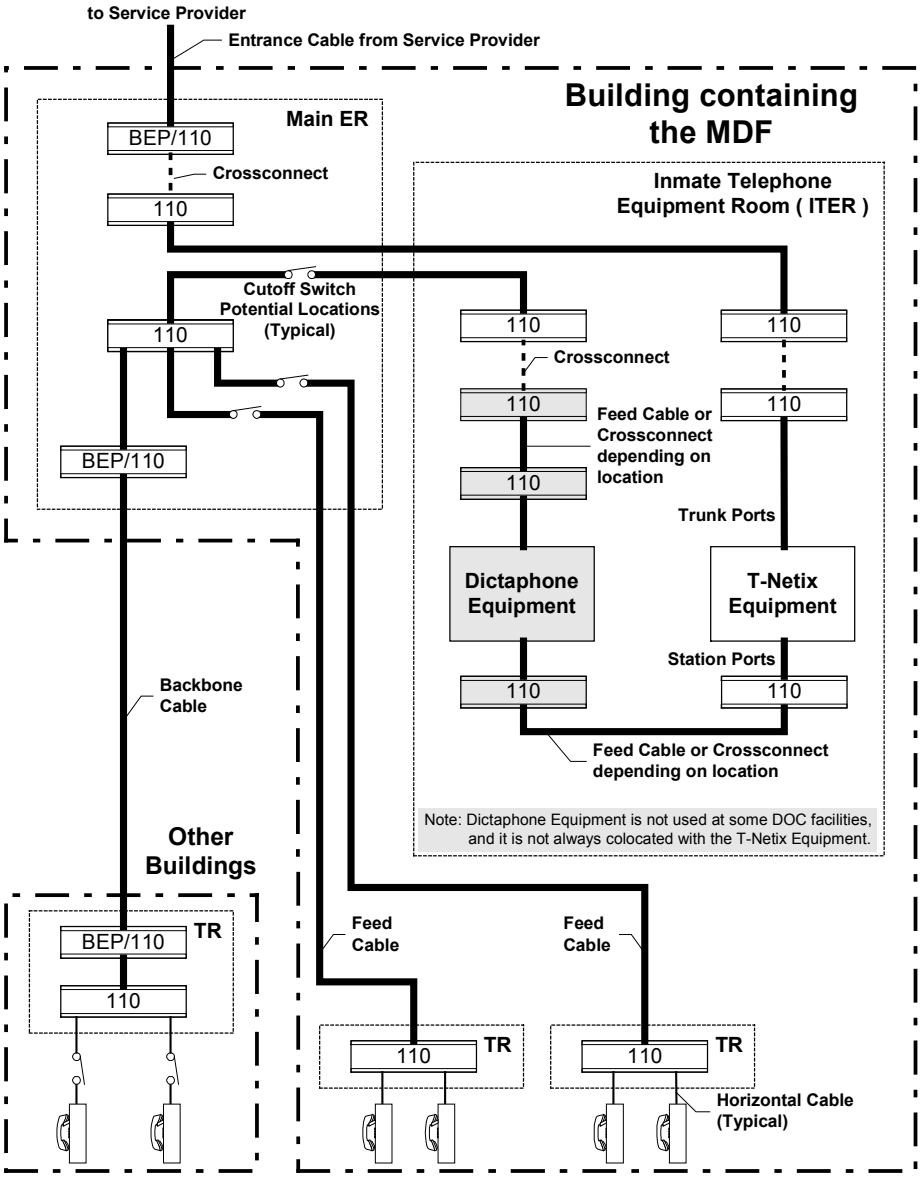
1. The Designer shall obtain site-specific design requirements from DOC IT regarding the configuration of cabling to support the inmate telephone system.
2. Inmate telephone inter-building backbone and intra-building feed cables shall be separate cables (separate sheath) from all other voice and data services. While it is preferred that the inmate telephone service cable enter the facility on a separate sheath service entrance cable (separate from the cable carrying administrative telephone services), DOC will accept both administrative and inmate telephone services provided over a single service entrance cable.
3. Inmate telephone inter-building backbone and intra-building feed cables shall be terminated on primary protectors and termination blocks that are separate from all other services.
4. All termination blocks for inmate cables in the Main ER and each building TR shall be located inside lockable cabinets. These measures are necessary to prevent inadvertent cross-connection between inmate telephone and administrative DOC circuits, unauthorized monitoring of inmate circuits, or unauthorized monitoring of administrative circuits by inmates.
5. From the service entrance cable termination (directly from the separate primary protectors) in the Main ER, the inmate telephone cables shall cross-connect to separate, dedicated termination blocks located inside a lockable cabinet.
6. Inmate telephone backbone or feed cables shall route from the Main ER to a termination in a physically separate inmate telephone equipment room (ITER) as directly as possible.
7. The ITER may be located in a different building from the location of the Main ER.
8. The local DOC Intelligence & Investigations (I&I) staff will determine whether the termination blocks for inmate backbone and feed cables are enclosed in lockable cabinets within the ITER.
9. The ITER houses T-Netix switching equipment for the inmate telephones at all DOC prison facilities, both camps and major institutions. The T-Netix switch is the interface between the inmate telephones and outside telephone connectivity. The T-Netix switch provides unique call restrictions on an individual basis for each inmate.
10. Cabling from all inmate telephones must be connected to the T-Netix switch (except for legal/attorney phones).
11. The inter-building OSP backbone cable for the inmate telephone system will originate from either the Main ER or the ITER. If the inter-building backbone cable originates from the Main ER, two separate sheathed intra-building feed cables (one for the telephone station pairs and one for the service trunk pairs) will be required from the

Main ER to the ITER.

12. At major institutions, the ITER also houses Dictaphone equipment for monitoring and recording of inmate telephone calls. The Dictaphone equipment is connected between the cabling from the inmate telephones and the T-Netix switch.
13. A digit grabber unit may also be used in conjunction with the Dictaphone equipment. If used, it which would be connected between the cabling from the inmate phones and the Dictaphone equipment.

The following diagram depicts the cabling configuration of an inmate telephone system used at a typical DOC facility. Please note that the diagram shows the systems typically present at many facilities, however the physical locations of each component vary from site to site (Dictaphone equipment, cutoff switches, etc.).

Inmate Telephone System Cabling



Note: All BEPs and 110 Blocks used for inmate telephone cabling and that are located in any ER or TR outside the ITER shall be installed in lockable, wall-mounted metal enclosures.

4.5.4.3 Fiber Optic Backbone Cabling

A. During the Design Development phase, the Designer shall contact AVAYA fiber optic cable sources and obtain their projections of the lead-time requirements for AVAYA fiber optic cabling. This information shall be submitted to DOC IT to aid project-scheduling efforts and determine whether cable should be pre-ordered.

B. OSP fiber optic cable installed underground shall be loose tube construction and gel-filled or be constructed of appropriate waterproofing compounds.

C. DOC does not permit the design of any fiber optic cabling solution that is dependent on splices.

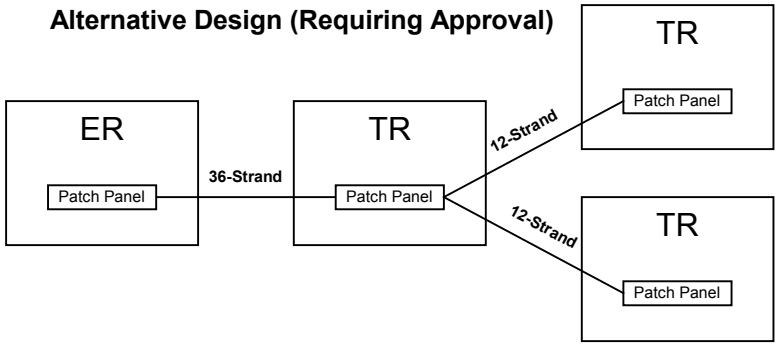
D. The Designer shall consult with the DOC IT Infrastructure Specialist prior to developing the fiber optic design to determine the performance requirements for the network electronics.
1. The Designer shall provide to DOC IT the estimated cable length between the fiber patch panels of each TR and the main ER fiber patch panel in the design phase. DOC IT will base its design of the LAN switches on the estimated lengths of the backbone cable runs between each telecommunications room and the Main ER.
2. As early as possible in the construction and installation phase, the Designer shall obtain the actual cable lengths and compare them with the estimated lengths. Any variances shall be reported to the DOC IT Infrastructure Specialist immediately.

E. Fiber optic cabling shall be terminated in a Fiber Optic Interconnection Unit patch panel. Avaya offers rack-mounted units that will mount directly into a standard EIA 19-inch equipment rack, and wall-mounted interconnection units that may be mounted on a plywood backboard.
1. Where equipment racks are installed, the rack-mountable Fiber Optic Interconnection Units shall be used.
2. The standard fiber optic connector for DOC is the type 568SC Duplex. When fiber additions are made to existing facilities where type 568ST connectors are in use, new 568SC Duplex connectors and new Duplex SC patch panels shall be used for new fiber.
3. For major renovations and remodeling to existing facilities where type 568ST connectors are currently in use, the existing connectors, patch panels and patch cables shall be replaced with type 568SC Duplex components.
4. All strands of a fiber optic cable shall be terminated using fusion-spliced pigtail connectors. The installation of "dark fiber" is not permitted.

F. Fiber optic cable and components shall be rated and installed to comply with the IEEE 802.3z 1000Base-X Ethernet Gigabit Standard. DOC networks depend on Gigabit and higher backbone speeds. Due to the distance limitations of multimode fiber (300m for SX, 550m for LX), singlemode fiber optic cable will be required to support most Gigabit and higher applications in the longer distances encountered in prison networks.

G. Fiber optic backbone cables shall home-run through conduit from each individual TR to the Main Telecommunications Equipment Room (ER), which should be the location of the data center. Very few if any exceptions will be granted because an alternative design will almost always result in excessive dB losses that violate the IEEE 802.3z 1000Base-X Ethernet Gigabit Standard. It is desirable to preserve as much dB headroom as possible to allow for splicing in the event of future cable damage.
- If an alternative design is approved for a main backbone cable to interconnect

to multiple branch backbone cables, the number of strands in the main backbone cable shall be greater than the sum of all branch backbone cables. For example:



H. DOC's general strategy for fiber optic backbone size is to install 12 strands of singlemode fiber optic cable and 12 strands of 62.5/125 micron graded index multimode fiber optic cable to each building. The fiber strand count shall be increased as required to meet the current and future needs of specific buildings or applications. Fiber optic backbone cables shall be designed with a minimum of 20% spare strands.

I. Where an alternative design has been approved to install fiber optic cable with less than 12 strands to small buildings such as utility buildings, no less than 6-strands of singlemode and 6-strands of multimode fiber shall be installed. However, fiber backbone cable runs exceeding 275 meters shall have at least 12 strands of singlemode fiber included.

J. Where an alternative design has been approved to install multimode-only fiber cable to small buildings, the total cable distance shall not exceed 275 meters from the TR of the small building to the main ER. The conduit shall also have sufficient capacity to install singlemode fiber in the future. Otherwise, both multimode and singlemode or a composite cable containing both singlemode and multimode fiber shall be used.

K. Prior to designing outside plant fiber optic cabling systems, the Designer shall seek direction from the DOC IT Infrastructure Specialist regarding the use of composite fiber optic cable versus separate multimode and singlemode cabling for a particular project.
   1. Using separate singlemode and multimode cables helps to identify the two fiber types, reducing confusion at patch panels and approved splice points during installation, maintenance, and administration. Singlemode and multimode fiber shall be terminated on separate rows of the patch panels, and clearly identified with labeling and the appropriate industry standard color code (blue for singlemode, beige for multimode).
   2. Composite cable containing both singlemode and multimode strands can be useful when retrofitting an existing facility, where existing outside plant conduit space may be limited. Also, the labor cost for pulling a single composite cable through outside plant telecommunications ductbanks is typically less than the

labor cost for pulling two separate fiber optic cables (one multimode and one singlemode).

L. Fiber optic cable with metallic armoring should only be used where the armor may be required for protection against rodents. The design of fiber optic cabling with metallic armoring requires alternative design approval.

M. In new construction and new conduit, fiber optic backbone cables shall be installed in fiber optic innerduct. Normally, three 1¼" innerducts can be placed in a 4-inch conduit. Where fiber optic cable is installed into existing conduits, the use of fiber optic innerduct is required if space is available. Design or installation of fiber optic cabling without the use of innerduct shall require approval through the "Alternative Design Request" process.

4.5.4.4 Fiber Optic Patch Cords

A. Fiber optic patch cables shall be factory manufactured Avaya SYSTIMAX® cables
- Fiber optic patch cables shall interconnect with the site backbone using Duplex SC connectors. If low voltage equipment is not available with SC connectors, then AVAYA SC/ST fiber patch cables shall be used.

B. Mode-conditioning patch cords shall be used for 1000BASE-LX runs over multimode fiber optic cable where the length is between 275 meters and 550 meters:
- Between the work area outlet and the LAN attached device.
- Between the TR patch panel and the LAN switch.

4.6 WORK AREAS

Please refer to the *Work Areas* section of the BICSI TDMM for general information regarding the design of work area communications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

A. Undercarpet telecommunications cabling (UTC) solutions shall not be used at DOC facilities.

B. There shall be at least one general-purpose convenience power outlet (120VAC, 15 Ampere minimum) located within three feet of every telecommunications outlet. The Designer shall discuss any application-specific needs with DOC IT staff and adjust the general-purpose convenience power outlet locations and amperage accordingly. Where work area power outlets are intended for dedicated telecommunications purposes, they shall be orange in color.

C. Telecommunications outlet faceplates used throughout a facility (in both secured and non-secured areas) shall be mounted with tamper-proof screws. Recommended screw heads are the "Torx Tamper-Resistant Head" and the "Pin-in-Socket Hex Head." Both of these screw head types have a pin in the center of the screw head

that prevents the insertion of home made tools. The Designer shall obtain approval from the facility superintendent or designated senior security officer for the type of tamper-proof screw to be used.

D. Either plastic or stainless steel outlet faceplates may be used throughout a facility at the discretion of each facility. DOC personnel shall consider the security implications when selecting the faceplate type. Plastic faceplates can be more easily broken. Stainless steel faceplates are more difficult to remove. Either type can be fashioned into a weapon.

E. Media converters shall not be used in DOC installations.

4.6.1 NON-SECURED AREAS

A. Horizontal telecommunications pathway in non-secured areas shall be designed consistent with industry codes, standards, and the guidelines in the BICSI TDMM.

B. Any Avaya SYSTIMAX® approved faceplate, frame, or surface mounted box may be used to mount Modular Information Outlets, as applicable to the particular installation, with the following restrictions:
- Faceplates with angled connectors are not permitted.

4.6.2 SECURED AREAS

A. Horizontal telecommunications pathway in secured areas shall be designed consistent with industry codes, standards, and the guidelines in the BICSI TDMM.

B. Any Avaya SYSTIMAX® approved faceplate, frame, or surface mounted box may be used to mount Modular Information Outlets, as applicable to the particular installation, with the following restrictions:
1. Telecommunications outlets shall be located to minimize the length of patch cord required to connect the computer or telephone to the outlet. Patch cords can easily be disconnected and used as a weapon.
2. Multi-User Telecommunications Outlet Assembly (MUTOA), shall not be used inside secured areas except for classrooms and multipurpose rooms.

4.7 TELECOMMUNICATIONS ROOMS

Please refer to the *Telecommunications Rooms* section of the BICSI TDMM for general information regarding the design of telecommunications rooms. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

A. The Telecommunications Room (TR) shall be dedicated to telecommunications functions. It is the location(s) in a building where the telecommunications cabling is terminated. In DOC facilities, the TRs in a building may also serve as low voltage systems equipment rooms, typically containing electronic equipment intended to serve the building or a portion of the building. The TR shall not be

shared with electrical installations other than those necessary for telecommunications.

B. The Designer shall be responsible to inform the Architect of the sizing and location requirements for Telecommunications Rooms during the Schematic Design phase of the project.

4.7.1 TELECOMMUNICATIONS ROOM LOCATION

A. Telecommunications Rooms shall not be co-located with any type of electrical room, mechanical room or closet, and shall not be located directly adjacent to these rooms or closets. The TR location shall maintain the separation distances identified in the *DOC EMI Source Separation Table* (see the *Electromagnetic Compatibility* subsection of this document).

B. When planning the size and location of TRs in existing buildings, the Designer shall make every reasonable effort to meet the requirements for telecommunications rooms.

C. TRs and telecommunications cabinets shall not be located within twenty feet of electrical transformers with a winding rated at greater than $480V_{rms}$.

4.7.2 TELECOMMUNICATIONS ROOM SIZING

A. ANSI/TIA/EIA-569-A provides Standards for sizing a TR for normal office buildings. The sizing is based on the "usable floor space," which is the space on a floor that can actually be used for office activities. Spaces such as mechanical rooms, janitorial closets, and rest rooms cannot be used for office activities, and are therefore not counted as usable floor space. The sizing formula assumes an average of 100 square feet of floor space for each person, or "work area."

B. Many DOC buildings are not traditional commercial or office buildings, and the sizing Standards of ANSI/TIA/EIA-569-A shall be adjusted to accommodate these buildings. When calculating the size required for a TR in a DOC building, the following steps shall be followed:

1. Determine the total square footage of all office space in the area to be served by the TR.
2. Determine all other locations in the area to be served by the TR, where voice and/or data service will be provided. Other locations would include, but are not limited to Corrections Officers duty stations, and inmate phone locations. Count each location as 100 square feet of usable floor space.
3. Add together the total office space and total "other" usable floor space resulting in the total area to be served by the TR.
4. Size the TR based on the following table:

Total Usable Floor Space	Telecommunications Room Size
5,000 SQUARE FEET OR LESS	10 FT. X 8 FT.
5,001 - 8,000 SQUARE FEET	10 FT. X 9 FT.
8,001 - 10,000 SQUARE FEET	10 FT. X 11 FT.

C. There shall be a minimum of one TR per building. Additional TRs shall be added when the area to be served exceeds 10,000 square feet or where the cable lengths will exceed 295 feet between the patch panel and the work area telecommunications outlet.

4.7.3 ARCHITECTURAL PROVISIONING

A. The Designer shall be responsible to inform the Architect of the architectural provisioning requirements for Telecommunications Rooms and to do this early in the Design Development phase of the project.

B. The walls in telecommunications rooms shall be covered with plywood backboards. The plywood shall be painted with two coats of white, fire retardant paint. The plywood shall ***not*** be fire retardant (fire retardant paint tends to flake off of fire retardant plywood).

C. In most cases it is preferable that the plywood shall extend from the floor to a height of eight feet above the finished floor. In TRs where the power conduits are retrofitted in a surface mounted fashion, it might be convenient to mount the plywood at a height of 6″ above the finished floor, extending to 8′6″ above the finished floor. The 6″ space below the backboard can then be used to route the power conduits to the outlets without obstructing plywood backboard space.

D. In new construction, power and telecommunications outlets, and light switches in the TR shall be surface mounted on the plywood backboard. In some cases where telecommunications backboards are applied to existing walls with existing power outlets and light switches, cutouts in the backboards shall be provided for access to the existing electrical devices.

E. In addition to the requirements in the BICSI TDMM, telecommunications rooms shall be environmentally provisioned as follows:
1. The walls and ceiling shall be treated and sealed to eliminate dust. False ceilings are not allowed in TRs. Finishes shall be light in color to enhance room lighting.
2. The floors shall be light colored, fire retardant, slip resistant. Carpet is not acceptable for telecommunications spaces.

F. The Designer shall be responsible to determine that the architectural requirements

for the telecommunications spaces are met as described in this document. For projects where an architect is involved, the Designer shall coordinate directly with the architect, and verify that the architect's design documentation meets these requirements. For projects without the involvement of an architect, the Designer shall alert DOC where additional architectural elements are needed to meet the requirements.

4.7.4 ENVIRONMENTAL PROVISIONING

A. The Designer shall be responsible to inform the Mechanical Engineer of the environmental provisioning requirements for Telecommunications Rooms and to do this early in the Design Development phase of the project.

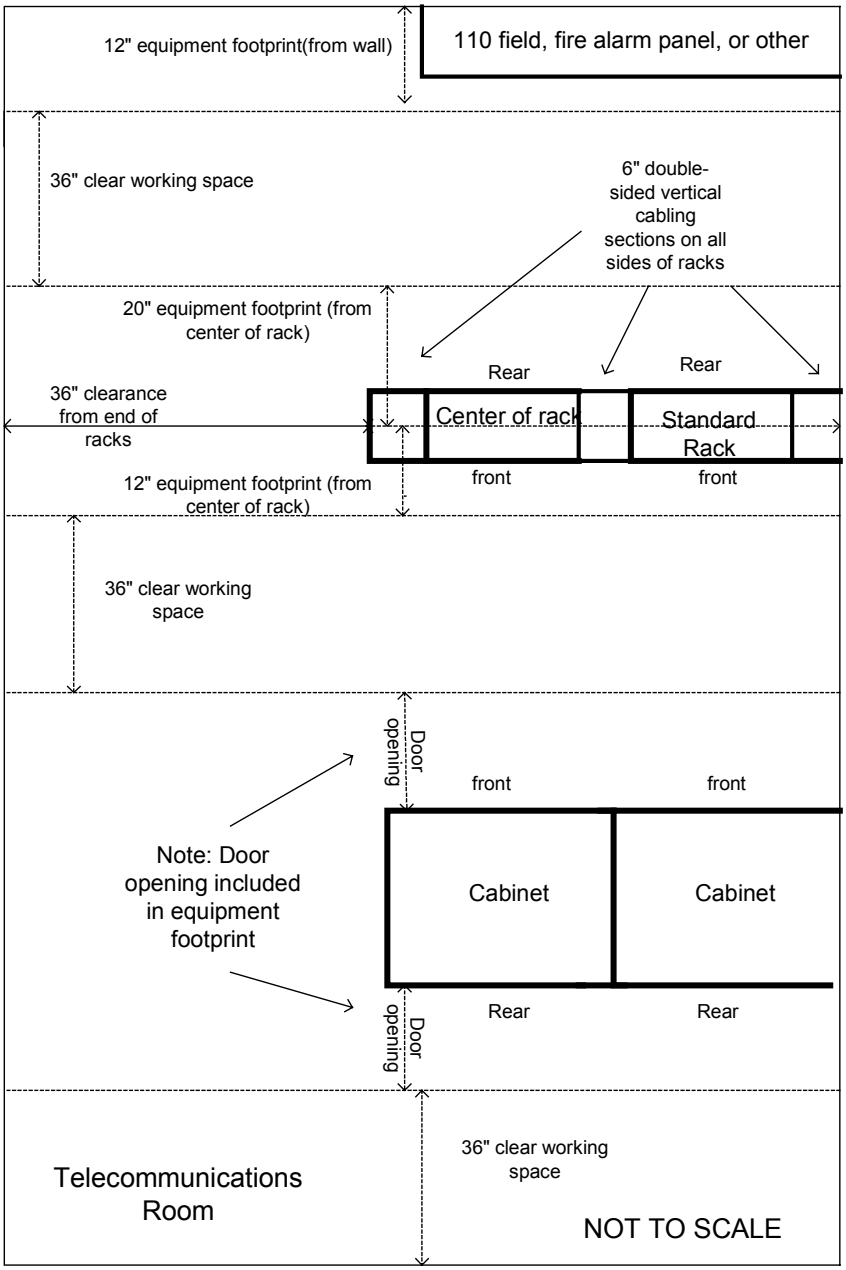
B. In addition to the requirements in the BICSI TDMM, telecommunications rooms shall be environmentally provisioned as follows:
   1. A fundamental design assumption is that all TRs will at some time contain active electronic equipment (hubs, routers, switches, etc.) even if the current design does not call for such devices. Network electronics require an HVAC system capable of operating on a 24 hours-per-day, 365 days-per-year basis. If the building system cannot assure continuous operation, a stand-alone unit shall be provided for the TR.
   2. Minimum clearance height in the TR shall be eight feet without obstructions.
   3. Fire suppression sprinklers shall be equipped with wire cages under the sprinkler heads to prevent accidental discharge. Drainage troughs shall be placed under the sprinkler pipes to prevent leakage onto the equipment within the room.
   4. Doors shall open out from telecommunications spaces wherever possible. Doors shall be located in hallways or other common areas. In no case shall the door be located in another building occupants' designated space.

C. The Designer shall be responsible to determine that the mechanical requirements for the telecommunications spaces are met as described in this document. For projects where a mechanical engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of a mechanical engineer, the Designer shall alert DOC where additional mechanical infrastructure is needed to meet the requirements.

4.7.5 EQUIPMENT RACKS AND CABINETS

A. When designing the layout for Telecommunications Rooms, it is important to allow adequate space for both "Equipment Footprints" and "Clear Working Space."

The following diagram illustrates DOC's minimum Equipment Footprints and Clear Working Space requirements for Telecommunications Rooms:



A. Clear Working Spaces are required at both the front and rear of Equipment Footprints and out from walls at the end of at least one rack/cabinet row for maintenance access and installation of equipment. Provide a minimum of 36″ clear working space:

- out from Equipment Footprint of wall-mounted equipment.
- out from Equipment Footprint of racks/cabinets (both the front and rear).
- out from cabinet doors at the open position.
- out from at least one end of each rack/cabinet row.

B. Equipment Footprints consist of a variable depth to accommodate the overhang of equipment and cabling at the front and rear of racks, outbound from walls where equipment is directly mounted on walls or backboards and telecommunications cabling is terminated. The depth of equipment cabinet doors in their open position are included as part of the Equipment Footprint. The minimum width per rack/cabinet shall be 32 inches.

a. Provide a minimum of 32″ (2 ft 8 inches) depth for floor standing racks:
   - Provide a minimum of 12″ depth from centerline of rack to front of rack.
   - Provide a minimum of 20″ (1 foot, 8 inches) depth from centerline of rack to rear of rack.

b. Provide a minimum of 12″ depth off wall for most direct-to-wall mounted equipment and cabling not enclosed in a wall-mount rack or cabinet.
   - Where direct-to-wall mounted equipment exceeds this depth, use the actual depth of the mounted equipment and cabling.

c. For cabinets, as a minimum depth, use the depth of the cabinet plus the depth of the swing of the front and rear doors.
   - Include the depth of standoff brackets for wall-mount racks/cabinets.
   - Note: Wall-mount swing gate racks and cabinets require about double the wall space width to accommodate the gate/door when opened.

d. Provide an additional minimum width of 12″ for racks/cabinets to include 6″ wide double-sided vertical cabling sections on both the left and right sides. Side-by-side racks shall also have at least one 6″ wide double-sided vertical cabling section between each rack.

4.7.5.1 Floor-standing Equipment Racks

A. EIA standard, 19-inch, open-frame equipment racks shall be provided in the TR. Floor standing racks shall be securely bolted to the floor, and shall be braced to the wall with cable ladder racking. Multiple racks in the same TR shall be interconnected with cable ladder racks.

B. Wall-mounted racks shall be double-hinged, providing access to both the front and rear of the equipment.

C. The Designer shall discuss with DOC the potential for future requirements for additional racks, and identify spaces for future racks on the plan drawings.

D. Racks shall be equipped with an appropriate number and type of horizontal and vertical wire management modules both front and rear with strain relief brackets to insure proper bend radius and insure that strain relief is maintained for "all" cables.

E. Some IT equipment requires equipment racks with both front and rear mounting rails. The Designer shall discuss with DOC the network electronics that will be hosted in each rack in each TR and shall show this equipment on the rack elevation details in the plan drawings.

4.7.5.2 Telecommunications Cabinets

A. In new construction, wall-mounted telecommunications cabinets shall only be permitted in guard towers. All other new buildings shall be designed with TRs and floor-mounted racks or cabinets.

B. In remodel construction, certain small buildings such as maintenance buildings or guard towers may not justify a separate room as the telecommunications room. In some existing buildings, sufficient space may not be available for a telecommunications room. In these instances, a wall-mounted or floor-mounted telecommunications cabinet may be used, but shall require approval by the DOC IT Infrastructure Specialist. The location of a telecommunications cabinet shall adhere to:

1. All of the requirements identified under the *Telecommunications Room Location* subsection of this document.
2. Both the Equipment Footprints and Clear Working Space requirements of this document.

C. The size of the cabinet and the conduits serving the building shall include space for future growth, and shall provide space for computer network equipment.

D. Telecommunications cabinets shall meet the following requirements:
- Cabinets shall have a minimum of 24" from the front rail to the wall.
- Wall-mounted cabinets shall be double-hinged, providing access to both the front and rear of the equipment.

E. Telecommunications cabinets shall provide physical security to protect the contents and prevent unauthorized access. The cabinets shall be constructed of heavy gauge steel, and be lockable. Any removable panels shall have tamper proof screws. The construction and locking characteristics of the cabinet shall be appropriate for the security rating of the area in which it is installed. Cabinets in secured areas shall not have Plexiglas or glass panels.

F. Power and telecommunications cables for equipment housed within the cabinet are to be contained within the cabinet. No exposed cables are allowed. Power and telecommunications cables routed to or from the cabinet shall be contained in conduit, surface mounted raceway, or concealed within the adjacent wall.

G. The cabinet shall contain a plywood backboard inside for mounting telecommunications hardware. It shall provide a means of mounting electronics equipment, including one or more LAN switches and UPS. Acceptable means are rails for rack mounting.

H. Any cabinet containing telecommunications equipment shall have cooling fans installed in the cabinet. The Designer shall coordinate with DOC and/or the electrical engineer to provide power for the cooling fans.

I. The cabinet shall have a telecommunications main grounding busbar (TMGB) installed in accordance with the grounding requirements discussed in Chapter 17 of the BICSI TDMM.

J. The cabinet shall not be located in or adjacent to areas containing sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power transformers, arc-welding equipment, radio transmitting antennas, etc.

4.7.6 POWER REQUIREMENTS

A. The Designer shall be responsible to determine that the power requirements for the telecommunications spaces are met as described in this document. For projects where an electrical engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of an electrical engineer, the Designer shall alert DOC where additional power infrastructure is needed to meet the requirements.

B. All electrical plans for new or altered electrical installations in DOC facilities must be reviewed by the Washington State Department of Labor and Industries and approved prior to construction, per WAC 296-46A-130 and WAC 296-46A-140.

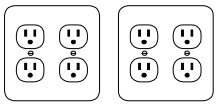
4.7.6.1 Technical Power Outlets

A. Power outlets shall be provided for exclusive use by telecommunications related electronic equipment. These outlets shall be colored orange, labeled as "Technical Power" and shall show the panel and circuit numbers. Technical power outlets shall be equipped for "straight-blade plugs" (NEMA 5-20R), rather than twist-lock style receptacles.

B. The Designer shall obtain connection/load requirements from DOC for each piece of equipment, and tabulate the information for review and confirmation by DOC.

4.7.6.1.1 Technical Power Outlets for Equipment Racks

A. Each equipment rack shall be equipped with a minimum of two quad power outlets (120VAC, 20 Ampere), each on its own dedicated circuit breaker.

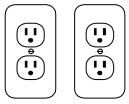


B. Outlets shall be located at the base of the rack such that they will not interfere with the placement of equipment (UPS, network electronics, etc.) in the bottom spaces of the rack. It is particularly important to coordinate the location of outlets with "double-railed" equipment racks where applicable. Each outlet shall be equipped with a dedicated #12 AWG, insulated, solid copper, equipment-grounding conductor.

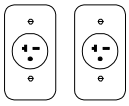
4.7.6.1.2 Power Outlets for Large, Rack-mounted Equipment

A. At DOC facilities, some IT equipment is fitted with dual power supplies (such as large LAN switches and routers). The Designer shall request that DOC identify where such equipment will be required, and then design accordingly. The design shall indicate where such equipment is intended to reside, and those racks shall have separate power outlets to service the large equipment, in addition to the two quad outlets discussed above. Each outlet shall be equipped with a dedicated #12 AWG, insulated, solid copper, equipment-grounding conductor.

B. Where the equipment requires 120 VAC power, the design shall provide for two duplex power outlets (120VAC, 20 Ampere) per piece of equipment having dual power supplies, each on its own dedicated circuit breaker.



C. Where the equipment requires 208 VAC power, the design shall provide for two simplex power outlets (208VAC, 20 Ampere) per piece of equipment having dual power supplies, each on its own dedicated circuit breaker.

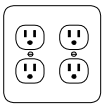


D. Outlets shall be located at the base of the rack such that they will not interfere with the placement of equipment (UPS, network electronics, etc.) in the bottom spaces of the rack.

E. These outlets are required in addition to the two quad power outlets required above for each rack.

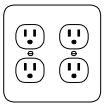
4.7.6.1.3 Technical Power Outlets for Telecommunications Cabinets

Each telecommunications cabinet shall be equipped with a minimum of one quad power outlet (120VAC, 20 Ampere) installed inside the cabinet, on a dedicated circuit breaker. The outlet shall be colored orange, identified as "Technical Power", and labeled with the panel and circuit numbers.

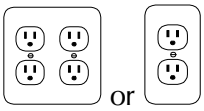


4.7.6.1.4 Wall-mounted Technical Power Outlets

A. One quad power outlet (120VAC, 20 Ampere) that is dedicated to telecommunications equipment shall be located every 12 feet along each wall.



B. The design shall provide for circuits to the other equipment as required, including:
- Service provider electronics
- PBX
- Inmate telephone equipment
- Voice mail servers



C. Each outlet shall be equipped with a dedicated #12 AWG, insulated, solid copper, equipment-grounding conductor. The design shall provide for not more than one outlet per circuit.

4.7.6.2 Technical Power Panels

A. The technical power circuits shall originate from a technical power panel, dedicated to serving the TR. The technical power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc welding, or industrial equipment. The power panel shall be located in the TR or in close proximity to the TR.
- Some small buildings (such as guard towers) might not justify a dedicated technical power panel. In these cases, an available general-purpose power panel may be used.
- If standby generator power is available to the facility, the TR technical power panel shall be served by the generator. Whenever possible, the Designer shall coordinate this with DOC on a case-by-case basis.

B. Where telecommunications cabinets are used in lieu of a TR, an available general-purpose power panel may be used to support the telecommunications cabinet power outlet. However, the power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc welding, or industrial equipment. The power panel shall be located in close proximity to the cabinet.

4.7.6.3 Convenience Power Outlets

A. In addition to the technical power outlets described above, the design shall provide for other duplex convenience outlets (120VAC, 15 Ampere) that are available for use with power tools and testing equipment. These outlets shall not be used to power telecommunications equipment. The convenience power outlets shall be placed at 6-foot intervals along the walls in the telecommunications room. These outlets shall be colored consistently with other convenience outlets in the building. Outlets shall be installed just below the bottom of the backboard (where backboards are installed at +6″ AFF). Each outlet shall be labeled with its panel identification and circuit number.

B. Where telecommunications cabinets are used in lieu of a TR, there shall be at least one general-purpose convenience power outlet (120VAC, 15 Ampere) located within six feet of each telecommunications cabinet. This outlet shall be colored consistently with other convenience outlets in the building. The general-purpose outlet shall not be used to power telecommunications equipment associated with the cabinet.

4.7.7 GROUNDING, BONDING, AND ELECTRICAL PROTECTION

All equipment racks, metallic conduits and exposed non-current carrying metal parts of telecommunications and information technology equipment in the TR shall be bonded to the TMGB. Refer to the *Grounding, Bonding and Electrical Protection* section of the BICSI TDMM and this document for more information regarding the design of grounding, bonding and electrical protection systems.

4.7.8 SUPPORT FOR INMATE TELEPHONE SERVICE

Telecommunications rooms serving inmate telephone locations shall have sufficient backboard space for cables and cable terminations to support inmate telephones that is physically separate from administrative telephone cables and cable terminations.

4.7.9 SUPPORT FOR CORRECTIONAL INDUSTRIES

Telecommunications rooms supporting Correctional Industries (CI) locations shall provide maximum flexibility.

1. Telecommunications Rooms serving CI locations shall be sized to allow a minimum of 25% growth.
2. All telecommunications distribution equipment shall be in a locked telecommunications room or locked steel telecommunications cabinet.

4.8 EQUIPMENT ROOMS

Please refer to the *Equipment Rooms* section of the BICSI TDMM for general information regarding the design of equipment rooms. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

A. The Main Telecommunications Equipment Room (ER) shall be dedicated to telecommunications functions. At DOC facilities, it is the central location on a campus where the major telecommunications equipment is located and where the main campus backbone cables terminate. The ER typically contains the telephone switching system, the data center with LAN file servers and server farms and wide area network (WAN) communications equipment. The ER shall not be shared with electrical installations other than those necessary for telecommunications.

B. The Designer shall be responsible to inform the Architect of the sizing and location requirements for Equipment Rooms during the Schematic Design phase of the project.

4.8.1 EQUIPMENT ROOM SIZING

A. The first step in determining the size required for the ER, is to identify the systems that will be installed into the ER. In this process, first identify the size of the area that will be served from the ER. The area might be an office suite at a Community Corrections office, a single building, or an entire campus at a corrections institution. Next, identify the quantity, size and variety of systems to be installed to

support the area, and the space required for each of the systems.

B. The Designer shall confer with the DOC IT Infrastructure Specialist to determine any sizing requirements for the ER on a project-by-project basis.

C. Once the size and quantity of systems are identified, they shall be laid out in a functionally efficient arrangement. Some equipment, such as WAN equipment, LAN servers, tape backup equipment, hubs, switches, and patch panels will require regular access, and shall be located where they are easily accessible.

D. The DOC IT Infrastructure Specialist and Regional ITM (or their designee) shall both be involved in this process, and shall approve the final space requirements and design layout for the equipment and racks.

E. When laying out the arrangement of the ER, the following requirements and issues shall be addressed:
1. Equipment shall be grouped together with like equipment (i.e., voice, data for both LAN and WAN, video.)
2. Designate wall space and equipment rack space for each specific use. Allocate specific backboard space for the service providers' demarcation areas and any associated equipment. The wall space allocated to the service providers (except inmate telephone services) shall be located adjacent to each other on a common wall and on a single aisle of equipment racks to concentrate the activities of service technicians in areas away from DOC-owned systems in other areas of the equipment room.
3. Provide a separate wall space area for demarcation of inmate telephone cable pairs, inter-building backbone cables, and intra-building feed cables (see the *Inmate Voice Backbone Cabling* subsection of this document). The Designer shall request additional information about cabling for inmate telephone systems (including schematic diagrams) from DOC IT.
4. Allocate separate wall and equipment rack space for terminating and cross connecting campus distribution cables (both copper and fiber optic). These areas shall be located adjacent to the equipment providing the services, such as the PBX, voice mail system, and data network electronics.

F. Once an acceptable equipment layout is developed, the size of the equipment room can be calculated. The design shall provide for a minimum of 25% vacant space for future growth.

4.8.2 EQUIPMENT ROOM LOCATION

A. Once the size has been determined, the location of the equipment room can be selected. To minimize both conduit and cable lengths, the ER shall be located as centralized as possible to the buildings on the prison campus.

B. In new construction, the ER shall be sized and provisioned to contain the major voice, data, and video equipment required to support the building or campus, and the other computer based and networked low voltage systems. In a renovation or

remodeling project with existing facilities, every reasonable effort shall be made to co-locate these systems in a common equipment room.

C. If the data center is in a location other than the ER, the DOC IT Infrastructure Specialist shall be consulted to design appropriately sized fiber optic cables to route from the ER to the data center. All interconnections between the data center backbone and the campus distribution fiber optic backbone shall be located in the ER.

D. The Equipment Room shall be located outside the secured area of a prison to simplify access by service provider technicians and to provide additional security to critical telecommunications equipment in the event of an inmate disturbance inside the secured area. The building housing the main ER and the ER itself will be monitored as a part of the overall site security system.

E. Other major factors that affect the location of the ER are:
1. Access for delivery and installation of large equipment into the ER.
2. Access by DOC and service provider maintenance personnel.
3. Restrictions on unauthorized access.
4. Close proximity to service entrances for telecommunications and power.
5. Close proximity and centralized to the campus telecommunications distribution pathways (conduits and/or aerial distribution) to minimize the backbone cable lengths.

F. The ER shall ***not*** be located in any of the locations listed below:
1. Inside the Secured Area.
2. Areas subject to water or steam infiltration, particularly basements. A floor drain (with a trap primer) is required if there is any risk of water entering the ER.
3. Areas exposed to excessive heat or direct sunlight.
4. Areas exposed to corrosive atmospheric or environmental conditions.
5. Near or adjacent to potential sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power transformers, arc welding equipment, or high power radio transmitting antennas.

4.8.3 ARCHITECTURAL PROVISIONING

A. The Designer shall be responsible to inform the Architect of the architectural provisioning requirements for Equipment Rooms and to do this early in the Design Development phase of the project.

B. Special security consideration shall be given to:
1. The material used for exterior walls
2. The size and style of windows
3. The use of heavier doors with heavy-duty locks
4. The vents and roof-mounted HVAC units

C. The design shall reflect the following important characteristics of the ER:
1. The ER shall be dedicated to the telecommunications and information

technology function. Shared use of boiler rooms, washrooms, janitor closets, electrical closets, or storage rooms is not allowed.

2. The door to the ER shall be a minimum 36 inches wide and 80 inches high, with all doors in the most direct route to the outside of the building being the same size, or larger. This sizing is necessary to accommodate delivery and installation of large equipment. Doors shall be located in hallways or other common areas. In no case shall the door be located in another building occupants' designated space.
3. The walls and ceiling shall be sealed to reduce dust. False ceilings are not allowed in ERs. Finishes shall be light in color to enhance room lighting.
4. Floors shall be sealed to reduce dust, light colored, fire retardant, slip resistant. Carpet is not acceptable for telecommunications spaces. In large equipment rooms, a raised access computer floor is required. The raised floor shall have a minimum of 8 inches clearance to the base floor, and shall not be used as an air plenum.
5. The room shall be free of plumbing and electrical utilities not directly required to support the telecommunications functions.
6. The ER at a prison shall have a security system installed to detect and alarm the following three conditions at the facility's major control: violations of intrusion, high temperature, and loss of electrical power. If the ER is housed in a building that is separate from other occupied administrative buildings, the security system shall include alarm annunciation lighting mounted on the building exterior.

D. The walls in equipment rooms shall be covered with plywood backboards. The plywood shall be painted with two coats of fire retardant paint. The plywood shall ***not*** be fire retardant (fire retardant paint tends to flake off of fire retardant plywood).

E. In most cases it is preferable that the plywood shall extend from the floor to a height of eight feet above the finished floor. In ERs where the power conduits are retrofitted in a surface mounted fashion, it might be convenient to mount the plywood at a height of 6″ above the finished floor, extending to 8′6″ above the finished floor. The 6″ space below the backboard can then be used to route the power conduits to the outlets without obstructing plywood backboard space.

F. In new construction, power and telecommunications outlets, and light switches in the ER shall be surface mounted on the plywood backboard. In some cases where telecommunications backboards are applied to existing walls with existing power outlets and light switches, cutouts in the backboards shall be provided for access to the existing electrical devices.

G. The Designer shall be responsible to determine that the architectural requirements for the telecommunications spaces are met as described in this document. For projects where an architect is involved, the Designer shall coordinate directly with the architect, and verify that the architect's design documentation meets these requirements. For projects without the involvement of an architect, the Designer shall alert DOC where additional architectural elements are needed to meet the requirements.

4.8.4 ENVIRONMENTAL PROVISIONING

A. The Designer shall be responsible to inform the Mechanical Engineer of the environmental provisioning requirements for Equipment Rooms and to do this early in the Design Development phase of the project.

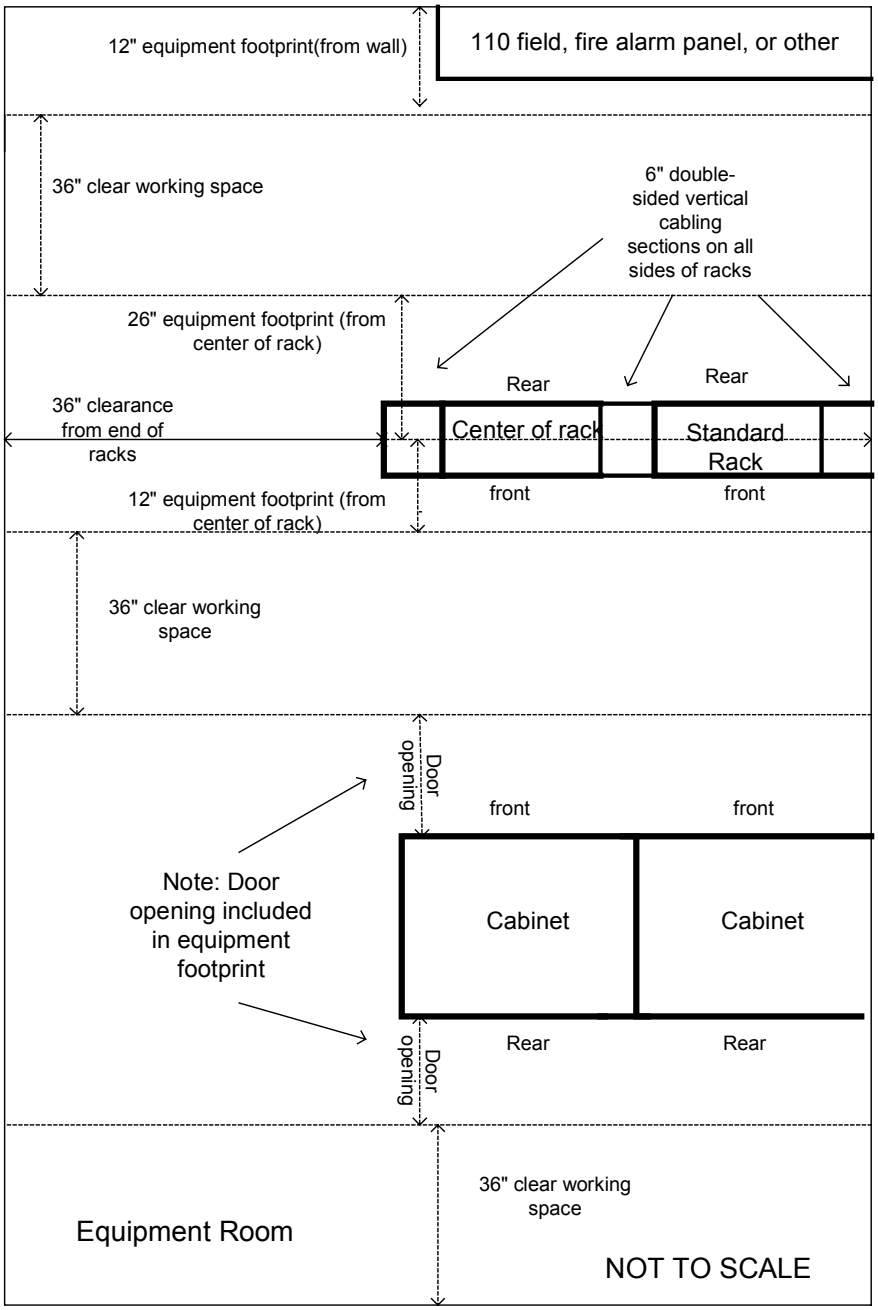
B. Equipment rooms shall be environmentally provisioned as follows:
   1. ERs will require an HVAC system capable of operating on a 24 hours-per-day, 365 days-per-year basis. Electrical power provisions shall be made to allow the HVAC system to operate on emergency power when commercial power is disrupted. If the building HVAC system cannot assure continuous operation, a stand-alone (backup) HVAC unit shall be provided for the ER and connected to emergency generator power. Where humidity levels exceed the limits allowed in the BICSI TDMM, provide dehumidification equipment.
   2. A high temperature alarm shall be provided and shall be connected to an annunciator located at the Master Control position.
   3. Minimum clearance height in the ER shall be eight feet without obstructions.
   4. A clean agent fire suppression system is required in the ER of medium to large prisons, and strongly recommended for small prison sites. If fire suppression sprinklers are also installed in the ER:
      - A cut-off valve shall be installed to keep the sprinkler heads dry and charged only in the event additional fire suppression is required after expression of the clean agent.
      - Sprinklers shall be equipped with wire cages under the sprinkler heads to prevent accidental discharge.
      - Drainage troughs shall be placed under the sprinkler pipes to prevent leakage onto the equipment within the room.
   5. When sprinklers or other water handling equipment are located in the ER, or where the potential for ingress of water exists, a free-flowing floor drain shall be installed wherever practical.

C. The Designer shall be responsible to determine that the mechanical requirements for the equipment rooms are met as described in this document. For projects where a mechanical engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of a mechanical engineer, the Designer shall alert DOC where additional mechanical infrastructure is needed to meet the requirements.

4.8.5 EQUIPMENT RACKS & CABINETS

A. When designing the layout for Equipment Rooms, it is important to allow adequate space for both "Equipment Footprints" and "Clear Working Space."

   The following diagram illustrates DOC's minimum Equipment Footprints and Clear Working Space requirements for Telecommunications Rooms



1. Clear Working Spaces are required at both the front and rear of Equipment Footprints and out from walls at the end of at least one rack/cabinet row for maintenance access and installation of equipment. Provide a minimum of 36″ clear working space:
    - out from Equipment Footprint of wall-mounted equipment.
    - out from Equipment Footprint of racks/cabinets (both the front and rear).
    - out from cabinet doors at the open position.
    - out from at least one end of each rack/cabinet row.

2. Equipment Footprints consist of a variable depth to accommodate the overhang of equipment and cabling at the front and rear of racks, outbound from walls where equipment is directly mounted on walls or backboards and telecommunications cabling is terminated. The depth of equipment cabinet doors in their open position are included as part of the Equipment Footprint. The minimum width per rack/cabinet shall be 32 inches.
    a. Provide a minimum of 38″ (3 ft 2 inches) depth for floor standing racks:
        - Provide a minimum of 12″ depth from centerline of rack to front of rack.
        - Provide a minimum of 26″ (2 foot, 2 inches) depth from centerline of rack to rear of rack.
    b. Provide a minimum of 12″ depth off wall for most direct-to-wall mounted equipment and cabling not enclosed in a wall-mount rack or cabinet.
        - Where direct-to-wall mounted equipment exceeds this depth, use the actual depth of the mounted equipment and cabling.
    c. For cabinets, as a minimum depth, use the depth of the cabinet plus the depth of the swing of the front and rear doors.
        - Include the depth of standoff brackets for wall-mount racks/cabinets.
        - Note: Wall-mount swing gate racks and cabinets require about double the wall space width to accommodate the gate/door when opened.
    d. Provide an additional minimum width of 12″ for racks/cabinets to include 6″ wide double-sided vertical cabling sections on both the left and right sides. Side-by-side racks shall also have at least one 6″ wide double-sided vertical cabling section between each rack.

4.8.5.1 Floor-standing Equipment Racks and Cabinets

A. EIA standard, 19-inch, open-frame equipment racks or enclosed cabinets shall be provided in the ER. Floor standing racks/cabinets shall be securely bolted to the floor, and shall be braced to the wall with cable ladder racking. Multiple racks/cabinets in the same ER shall be interconnected with cable ladder racks.

B. Some IT equipment requires an equipment rack with both front and rear mounting rails. The Designer shall discuss with DOC the network electronics that will be hosted in each rack/cabinet in the ER and shall show this equipment on the rack elevation details in the plan drawings. See Appendix 6.4, Sample Combination Rack/Wall Elevation Detail with Cutover Plan)

C. Racks/cabinets shall be equipped with an appropriate number and type of horizontal and vertical wire management modules both front and rear with strain relief brackets to insure proper bend radius and insure that strain relief is maintained for all cables.

D. The Designer shall discuss with DOC the potential for future requirements for additional racks/cabinets, and identify spaces for future racks/cabinets on the plan drawings.

E. Other styles of equipment racks and cabinets might be used in the ER, some of which will be proprietary to a particular system or service provider. The Designer shall plan the ER layout to make allowances for proprietary equipment and racks, and allow expansion room for future equipment.

4.8.6 POWER REQUIREMENTS

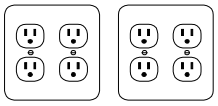
The Designer shall be responsible to determine that the power requirements for the equipment rooms are met as described in this document. For projects where an electrical engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of an electrical engineer, the Designer shall alert DOC where additional power infrastructure is needed to meet the requirements.

4.8.6.1 Technical Power Outlets

Power outlets shall be provided for exclusive use by telecommunications related electronic equipment. These outlets shall be colored orange, labeled as "Technical Power" and shall show the panel and circuit numbers. Technical power outlets shall be equipped for "straight-blade plugs" (NEMA 5-20R), rather than twist-lock style receptacles.

4.8.6.1.1 Technical Power Outlets for Equipment Racks

A. Each equipment rack shall be equipped with a minimum of two quad power outlets (120VAC, 20 Ampere), each on its own dedicated circuit breaker.

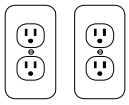


B. Outlets shall be located at the base of the rack such that they will not interfere with the placement of equipment (UPS, network electronics, etc.) in the bottom spaces of the rack. It is particularly important to coordinate the location of outlets with "double-railed" equipment racks where applicable. Each outlet shall be equipped with a dedicated #12 AWG, insulated, solid copper, equipment-grounding conductor.

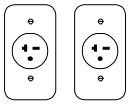
4.8.6.1.2 Power Outlets for Large, Rack-mounted Equipment

A. At DOC facilities, some IT equipment is fitted with dual power supplies (such as large LAN switches and routers). The Designer shall request that DOC identify where such equipment will be required, and then design accordingly. The design shall indicate where such equipment is intended to reside, and those racks shall have separate power outlets to service the large equipment, in addition to the two quad outlets discussed above. Each outlet shall be equipped with a dedicated #12 AWG, insulated, solid copper, equipment-grounding conductor.

B. Where the equipment requires 120 VAC power, the design shall provide for two duplex power outlets (120VAC, 20 Ampere) per piece of equipment having dual power supplies, each on its own dedicated circuit breaker.



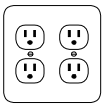
C. Where the equipment requires 208 VAC power, the design shall provide for two simplex power outlets (208VAC, 20 Ampere) per piece of equipment having dual power supplies, each on its own dedicated circuit breaker.



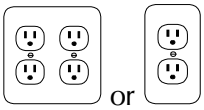
D. Outlets shall be located at the base of the rack such that they will not interfere with the placement of equipment (UPS, network electronics, etc.) in the bottom spaces of the rack.

4.8.6.1.3 Wall-mounted Technical Power Outlets

A. One quad power outlet (120VAC, 20 Ampere) that is dedicated to telecommunications equipment shall be located every 12 feet along each wall.



B. The design shall provide for circuits to the other equipment as required, including:



- Service provider electronics
- PBX
- Inmate telephone equipment
- Voice mail servers

C. Each outlet shall be equipped with a dedicated #12 AWG, insulated, solid copper, equipment-grounding conductor. The design shall provide for not more than one outlet per circuit.

4.8.6.2 Technical Power Panels

The following electrical provisions are required for the Main Telecommunications Equipment Room (ER):

A. The ER shall be equipped with a power disconnect switch located near the main door of the ER. The switch shall disconnect power to all electronic equipment in the ER, and is to be used in the event of electrocution or fire in the ER. There shall also be a similar means to disconnect the power to dedicated HVAC equipment serving the ER that shall also cause the fire/smoke dampers to close. Refer to the National Electrical Code, NFPA 70, Article 645-10 for further information.

B. A separate supply circuit serving the room shall be provided and terminated in its own electrical panel located in the ER. This power panel shall be designated as "ER Technical Power." The ER technical power panel shall be used exclusively for supplying power to electronics equipment in the equipment room. Sizing of

electrical power supply is dependent upon the equipment types and equipment load, and shall be calculated on a case-by-case basis, including sufficient spare capacity for future growth.

C. The technical power circuits shall originate from a technical power panel, dedicated to serving the ER. The technical power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc welding, or industrial equipment.

D. If standby generator power is available to the facility, the ER technical power panel shall be linked to the standby generator power supply.

E. In Equipment Rooms at large facilities, a centralized uninterruptible power supply (UPS) is required to support the electronics equipment in the ER. For smaller facilities, the Designer shall perform a lifecycle cost analysis to evaluate the appropriateness of using of a centralized UPS and make a recommendation to DOC.

1. A centralized UPS shall be located in a room that is equipped to vent battery gasses that are sometimes emitted by UPS batteries. A centralized UPS shall not be located within the ER that it serves. It shall provide a minimum of two hours run time for the supported low voltage systems hardware. The Designer shall request direction from the DOC IT Infrastructure Specialist regarding project specific needs for increased the run time.
2. Upon installation, a qualified electrician shall test new centralized UPS units for correct voltage prior to connecting DOC equipment. Rooms housing centralized UPS systems shall have the same environmental provisioning as the ER.
3. The design shall include a telecommunications outlet located near each UPS system for use with a network interface card that will be provided with the UPS. The UPS will communicate via the network with servers and other equipment to orchestrate a coordinated safe-shutdown of the equipment in the event of an extended power outage.
4. Some battery manufacturers claim that valve-regulated lead acid batteries do not emit gasses and therefore might not require mechanical systems for venting battery gasses. The Designer shall evaluate such claims for applicability on each project.

F. In all cases, power for critical network components such as servers, routers, switches, and telephone systems shall be provided through a UPS.

4.8.6.3 Convenience Power Outlets

In addition to the technical power outlets described above, the design shall provide for other duplex convenience outlets (120VAC, 15 Ampere) that are available for use with power tools and testing equipment. The general-purpose circuits shall not originate from the ER technical power panel. These outlets shall not be used to power telecommunications equipment. The convenience power outlets shall be placed at 6-foot intervals along the walls in the equipment room. These outlets shall be colored consistently with other convenience outlets in the building. Outlets shall be installed just below the bottom of the backboard (where backboards are installed at +6″ AFF). Each outlet shall be labeled with its panel identification and circuit number.

4.8.7 GROUNDING, BONDING, AND ELECTRICAL PROTECTION

All equipment racks, metallic conduits and exposed non-current carrying metal parts of telecommunications and information technology equipment in the ER shall be bonded to the TMGB. Please refer to the *Grounding, Bonding and Electrical Protection* section of the BICSI TDMM and this document for more information regarding the design of grounding, bonding and electrical protection systems.

4.8.8 SUPPORT FOR INMATE TELEPHONE SERVICE

The telecommunications pathways and spaces needed for supporting inmate telephone services shall be planned into the overall architectural design of the facility. Inmate telephone service is provided through contracts with various telecommunications carriers. As contracts expire, different contractors may be used to provide the services. As a result, it is generally in the best interest of DOC to plan, install, own, and maintain the telecommunications infrastructure supporting inmate telephone services. The Designer shall consider the following requirements when planning the telecommunications infrastructure and substructure to support inmate telephones:

A. The inmate telephone equipment room shall be located outside of the Secured Area if possible. It should also be located adjacent to the Intelligence and Investigations offices, and shall contain the inmate phone monitoring and recording equipment.
   1. Some applications with limited space might require a segregation solution to fence off or partition an area of the ER for inmate telecommunications equipment.
   2. Other applications might require the inmate telephone demarcation point to be located near the demarcation point for administrative telephone services and then extended from that point to the inmate telephone equipment room.

B. The inmate telephone equipment room shall have sufficient backboard space for the mounting of primary protectors, termination hardware, and cross connection hardware for the service entrance cables and campus distribution cables supporting inmate telephones.

C. Inmate telephone equipment rooms serving inmate telephone locations shall have sufficient backboard space for separate cables and cable terminations to support inmate telephones.

4.9 TELECOMMUNICATIONS ENTRANCE FACILITIES & TERMINATION

Please refer to the *Telecommunications Entrance Facilities & Termination* section of the BICSI TDMM for general information regarding the design of telecommunications entrance facilities. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

4.9.1 ENTRANCE FACILITY LOCATION

A. DOC requires that the EF be co-located with the Main Telecommunications Equipment Room (ER) for the facility.

B. The service providers' technicians will need access to the EF. Such access is simplified if the facility Entrance Facility and Equipment Room are located outside of the Secured Area.

C. DOC IT requires that the wide area network (WAN) equipment be located in the main ER, which is also the typical location of LAN server farms. DOC IT requires that services be obtained from the telecommunications service provider to extend the demarc for the WAN telecommunications circuit from the main demarc location to the location of the WAN equipment.

D. The Designer shall coordinate with the local service providers to determine their requirements for entrance facilities. These providers can include the Local Exchange Carrier (local telephone company), a long distance telephone company, a cable TV company, or some other service provider.

E. At DOC facilities, the Designer shall design a cable pathway (using 4" conduit) from the property line to the EF. The cable pathway shall be underground conduit, with telecommunications maintenance holes or handholes as necessary. Close coordination with each of the service providers is critical to determine that their requirements for entrance pathway are met. Some service providers will not share conduit or maintenance holes with other service providers. The design shall include at least 25% spare conduits.

F. The use of aerial distribution for entrance facilities is not allowed.

4.10 FIELD TESTING

Please refer to the *Field Testing* section of the BICSI TDMM for general information regarding the field-testing of telecommunications cabling. The following requirements take precedence over the BICSI TDMM guidelines for field-testing at DOC facilities:

A. The Designer shall review the cable test results submitted by the Contractor. The test results shall be the actual native machine test results downloaded from the test equipment.

B. The final test results shall have been verified by the Designer to be acceptable before submission to DOC. Test results shall be submitted to DOC in both electronic and paper forms.

4.11 RESIDENTIAL CABLING

Please refer to the *Residential Cabling* section of the BICSI TDMM for information regarding the design of telecommunications infrastructure to support residential facilities within DOC facilities.

While this type of facility will be uncommon at DOC facilities, the Designer shall inquire of DOC whether a "residential cabling" solution is required for a particular project. Please

note that the "residential cabling" solution will not be provided for inmate residences.

4.12 SPECIAL DESIGN CONSIDERATIONS

Please refer to the *Special Design Considerations* section of the BICSI TDMM for information regarding the design of telecommunications infrastructure in accordance with the Americans with Disabilities Act (ADA) requirements at DOC facilities.

A. The Designer shall request guidance from DOC regarding the requirements for coin-operated telephones within DOC facilities.
   1. Coin-operated telephones are typically not provided for use by the inmate population.
   2. Where coin-operated telephones are provided in DOC facilities, the "shelfette" style shall be used rather than a booth.

B. The Designer shall request guidance from DOC regarding the requirements for inmate telephones within DOC facilities.
   1. Inmate telephones are generally not located centrally. The Designer shall coordinate the locations of inmate telephones with the designated security representative at the facility.
   2. Inmate telephones shall not be designed to be located within separate booths.
   3. Inmate telephone calls are monitored and recorded.
   4. In some cases it might be necessary to provide TTY-type (text-based) inmate telephones for use by deaf inmates.
   5. Cabling to support inmate telephones shall be connected to a set of 110 blocks in the TR that is physically separated from the terminations for administrative telephone and data cabling.
   6. Cabling serving inmate telephones located outside shall not be routed aerially to the telephone locations. Instead, the cable shall be routed using underground conduit that is permanently attached to the telephones.
   7. Typically, the manufacturer of the inmate telephone system will install the inmate telephones at the locations indicated on the drawings and will connect the Contractor-provided unterminated, UTP cable to the telephone.

C. The Designer shall request guidance from DOC regarding the particular spaces within DOC facilities intended to include Americans with Disabilities Act (ADA) features. The design shall comply with the requirements of the ADA, in part to accommodate non-inmate employees and visitors.

D. Automatic Teller Machines (ATM) are typically not provided at DOC facilities.

4.13 TELECOMMUNICATIONS ADMINISTRATION

Please refer to the *Telecommunications Administration* section of the BICSI TDMM for general information regarding the documentation and labeling of telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

- Inside secured areas, doors leading to a TR shall ***not*** be labeled with a sign indicating the room name or purpose (contrary to the requirements of the BICSI TDMM).

4.13.1 IDENTIFICATION STRATEGY

A. The "identifier" is the unique name or description assigned to a telecommunications infrastructure component. The Designer shall assign identifiers to the telecommunications infrastructure components listed below and clearly show the identifier assignments on the Construction Documents. The Construction Documents shall include a tabulated report of the identifiers assigned within the scope of the project. The report shall include space for the Contractor to provide actual values for cabling and conduits (length, attenuation, etc.) that are obtained during the construction and testing processes.

B. While it is the Contractor's responsibility to provide marked-up drawings to the Designer indicating any construction-related changes to the identifiers, the Designer shall verify that the identifiers are clearly and accurately shown on the record drawings.

C. Telecommunications components shall not be labeled with an application-specific identifier. Ports shall not be labeled with the name or function of the device that is served by the port (server names, computer types. Also, the use of "V-#" and "D-#" are inconsistent with the industry standard-based philosophy of designing cabling systems that are independent of the application, and are therefore not permitted.

D. The TCGS contains a comprehensive listing of the identification strategy requirements, including some items that are not addressed below. The items listed below shall be shown on the Construction Documents, whereas the TCGS includes some identification and labeling requirements that do not typically appear on the Construction Documents.

4.13.1.1 New Telecommunications Distribution Systems

The Designer shall assign the identifiers to the telecommunications components based on the following identification strategy:

A. The Designer shall evaluate any existing identification strategy for Maintenance holes and handholes, considering the pros and cons of using the existing strategy versus applying a new strategy as follows: Maintenance holes and handholes shall be identified based on an alphanumeric grid system. A grid shall be superimposed over the site plan with gridlines shown at 100-foot intervals. The origin of the grid shall be in the lower left corner of the site plan (typically the south-west corner of the site). The vertical axis of the grid shall be labeled alphabetically and the horizontal axis shall be labeled numerically. Maintenance holes or handholes that lie within a square shall be labeled with an identifier based on the letter and number of that grid square. The format for these identifiers shall be "VHHX" where "V" represents the letter of the alphabet associated with the row (vertical axis) and "HH" represents a two-digit number (leading "0" if necessary) associated with the column (horizontal axis) wherein the maintenance hole or handhole is located.

The "X" represents a sequentially assigned letter to distinguish between multiple maintenance holes or handholes located within the same grid square.

- For example, a maintenance hole or handhole located in the square identified by the row "K" and the column "8" shall be identified as "K08A" (always use two digits for the column number). A second maintenance hole or handhole located in the same square shall be labeled "K08B" and so forth. A maintenance hole or handhole located in the square identified by the row "G" and the column "12" shall be identified as "G12A".

B. Campus Backbone cables shall have identifiers in the form of "M##" where "M" is either "F" (for fiber backbone media) or "C" (for copper backbone media) and "##" is a unique, two-digit sequential cable number.

- For example: The first three outside plant fiber backbone cables designed on a project shall be identified as "F01", "F02" and "F03". The eleventh, twelfth and thirteenth outside plant copper backbone cables designed on a project shall be identified as "C11", "C12" and "C13".

C. Telecommunications rooms (and Equipment Rooms) shall have identifiers in the form of "FX", where "F" is the floor number on which the telecommunications rooms resides and "X" represents a sequentially assigned letter to distinguish between multiple rooms on the floor.

- For example: A building with two telecommunications rooms on the third floor would have rooms labeled "3A" and "3B".

D. Racks in telecommunications rooms shall have identifiers of the form "R#" where "R" stands for "Rack" and "#" is the sequential rack number within a given TR.

- For example: The first rack in a given telecommunications room would have the label "R1", the second "R2" and so on.

E. Patch Panels shall have identifiers sequentially numbered in the form of "PP#" where "PP" stands for "Patch Panel" and "#" is the sequential patch panel number terminated within a given telecommunications room, regardless of media type (horizontal copper or horizontal fiber).

- For example: The first patch panel (terminating horizontal fiber optic cabling in duplex SC ports) would be labeled "PP1".
- For example: The second patch panel (terminating horizontal copper cabling) would have the label "PP2".

F. Ports on Patch Panels for Horizontal Cabling are typically pre-labeled by the manufacturer with sequential numbers (i.e. 1 to 48). For ports which are not pre-labeled, label each port in the form "##" where "##" is the sequential port number within the panel. The ports in each patch panel shall start at number "01".

- For example: The ports on a patch panel terminating horizontal fiber optic cabling in duplex SC ports would be labeled starting with "01" for the first duplex port (one label per pair of fiber strands) and continue sequentially through the remainder of the duplex ports.

G. Work Area Connectors (Ports) connected to patch panels in the telecommunications room shall have identifiers in the form of "TR-PP#-##" where

"TR" is the TR at which the horizontal cable terminates (see TELECOMMUNICATIONS ROOMS above), "PP#" is the patch panel identifier at which the horizontal cable terminates (see, PATCH PANELS above) and "##" is the port within the patch panel in which the horizontal cable terminates.

- For example: A work area with two copper connectors terminates in the second telecommunications room on the fourth floor, in the third copper patch panel, in ports 5 and 6. The connectors would have the labels "4B-PP3-05" and "4B-PP3-06."

H. Work Area Connectors (Ports) connected to termination blocks in the telecommunications room shall have identifiers in the form of "TR-110-###" where "TR" is the telecommunications room at which the horizontal cable terminates (see TELECOMMUNICATIONS ROOMS above), "110" refers to the 110-termination blocks (as opposed to a patch panel identifier) and "###" is the sequential termination block port, within a given termination block column, at which the horizontal cable terminates.

- For example: A work area with two copper connectors terminates in the second telecommunications room on the fourth floor on termination block ports 5 and 6. The connectors would have the labels "4B-110-005" and "4B-110-006."

4.13.1.2 Moves, Adds and Changes (MAC)

The only exception to the above identification strategy is that for small projects relating to moves or changes to existing cabling, or the addition of new outlets terminated among other existing cables in existing TRs. In such cases, the cable identification scheme for the new cables shall be consistent with the existing identification strategy.

4.14 DESIGN, CONSTRUCTION AND PROJECT MANAGEMENT

Please refer to the *Design, Construction and Project Management* section of the BICSI TDMM for information regarding design, construction and project management of telecommunications infrastructure at DOC facilities.

4.15 FIRE STOPPING

Please refer to the *Fire Stopping* section of the BICSI TDMM for general information regarding the design of fire stopping for telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

A. Penetrations through fire-rated walls and floors shall be fire-stopped in accordance with the requirements of the manufacturer of the fire-stopping materials and satisfy local code officials.

B. The Designer shall avoid design solutions calling for penetration of fire-rated walls and floors when other reasonable cable-routing options exist.

4.16 POWER DISTRIBUTION

Please refer to the *Power Distribution* section of the BICSI TDMM for general information regarding the design of power distribution for telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

A. The Designer shall be responsible to determine that the power requirements for the equipment rooms are met as described in this document. For projects where an electrical engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of an electrical engineer, the Designer shall alert DOC where additional power infrastructure is needed to meet the requirements.
   1. Please refer to the *Work Areas* section of the BICSI TDMM and also in Section 2.6 of this document for information on the power outlet requirements for work areas.
   2. Please refer to the *Telecommunications Rooms* section of the BICSI TDMM and also in Section 2.7 of this document for information on the power outlet requirements for TRs.
   3. Please refer to the *Equipment Rooms* section of the BICSI TDMM and also in Section 2.8 of this document for information on the power outlet requirements for ERs.

B. The design shall include a rack-mountable uninterruptible power supply (UPS) for each telecommunications rack and cabinet, unless a centralized UPS is used. The UPS shall be appropriately sized for the electrical load expected at each location.

4.17 GROUNDING BONDING AND ELECTRICAL PROTECTION

Please refer to the *Grounding, Bonding and Electrical Protection* section of the BICSI TDMM for general information regarding the design of grounding, bonding and electrical protection systems. See also the *Grounding, Bonding and Electrical Protection* section of the BICSI CO-OSP for more information. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

4.17.1 TELECOMMUNICATIONS GROUNDING AND BONDING INFRASTRUCTURE

A. A Telecommunications Main Grounding Busbar (TMGB) shall be installed at an accessible and convenient location in each Entrance Facility. A Telecommunications Grounding Busbar (TGB) shall be installed at an accessible and convenient location in each Equipment Room and Telecommunications Room. TMGBs and TGBs shall be sized to accommodate 30% future growth.

B. A green insulated stranded copper cable (sized between a minimum of #6 AWG and a maximum of 3/0 AWG) shall be provided between each TGB and TMGB and from the TMGB to the building main electrical service ground electrode. The

Designer shall evaluate the grounding cable size that will be appropriate for each application.

4.17.2 TELECOMMUNICATIONS CABLING

While DOC does not permit telecommunications design solutions to include splices to fiber optic cabling and also prefers that copper backbone cabling not be spliced, occasionally it becomes necessary to splice cables. Where any splices are made to backbone cables, the metallic shields of those cables shall be bonded together to maintain shield continuity.

4.18 ELECTROMAGNETIC COMPATIBILITY

Please refer to the *Electromagnetic Compatibility* section of the BICSI TDMM for general information regarding the electromagnetic interference with and clearance requirements for telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

Telecommunications infrastructure shall maintain minimum separation distances from sources of electromagnetic interference (EMI) as listed below. Where the NEC or local codes require greater separation distances than those listed below, the largest separation distance shall be maintained.

4.18.1 TELECOMMUNICATIONS & EQUIPMENT ROOMS

TRs shall not be located in or adjacent to areas containing sources of electromagnetic interference or radio frequency interference (RFI) such as photocopy equipment, large electric motors, power transformers, arc-welding equipment, radio transmitting antennas, fluorescent lighting, etc. This is a critical consideration, as EMI and RFI can render data networks inoperable. No point within the TR or ER shall be closer than 6 m (20 ft) to power panels or equipment rated at greater than 480 V.

4.18.2 INSIDE PLANT PROXIMITY TO SOURCES OF EMI

A. For the purposes of this document, sources of electromagnetic interference (EMI) are categorized with three different operating ranges:
   - Less than or equal to 220 V_{rms}
   - Greater than 220 V_{rms} and less than or equal to 480 V_{rms}
   - Greater than 480 V_{rms}

B. Allowable proximity to the various sources of EMI is defined for each of four categories of telecommunications infrastructure:
   - Crossconnect locations that are shielded (such as swing racks enclosed in metal cabinets)
   - Crossconnect locations that are unshielded (such as floor-standing equipment racks)
   - Telecommunications cabling that is shielded (cabling routed through metallic conduit or a metallic raceway that completely encloses the cabling).

- Telecommunications cabling that is unshielded (cabling routed through any raceway that does not completely enclose the cabling in metal).

C. The following table lists the required minimum separations between the different categories of EMI sources and telecommunications infrastructure. (To minimize the effects of EMI, telecommunications pathways shall cross perpendicular to electrical power cables, electrical power conduits and fluorescent lighting.)

	Telecommunications Infrastructure			
	Crossconnect Locations		Horizontal Cabling	
Sources of Electromagnetic Interference	***Unshielded***	Shielded	***Unshielded***	Shielded
Power Circuits Not in Metallic Raceway				
Less than 220 V_{rms}	2″	2″	2″	2″
Greater than 220 V_{rms} but less than 480 V_{rms}	10 ft	5 ft	5 ft	3 ft
Greater than 480 V_{rms}	20 ft	10 ft	10 ft	5 ft
Power Circuits in Metallic Raceway				
Less than 220 V_{rms}	2″	2″	2″	2″
Greater than 220 V_{rms} but less than 480 V_{rms}	5 ft	5 ft	3 ft	2 ft
Greater than 480 V_{rms}	10 ft	10 ft	5 ft	3 ft
Lightning Protection System Conductors	6 ft	6 ft	6 ft	6 ft
Ballasted Light Fixtures	1 ft	1 ft	1 ft	6″
Motors or Transformers				
Less than 220 V_{rms}	4 ft	2 ft	4 ft	1 ft
Greater than 220 V_{rms} but less than 480 V_{rms}	10 ft	5 ft	4 ft	2 ft
Greater than 480 V_{rms}	20 ft	15 ft	10 ft	5 ft
Metal Enclosed Electrical Panelboards, Motor Controls and Switchboards				
Less than 220 V_{rms}	4 ft	2 ft	2 ft	1 ft
Greater than 220 V_{rms} but less than 480 V_{rms}	10 ft	4 ft	4 ft	2 ft
Greater than 480 V_{rms}	20 ft	20 ft	10 ft	5 ft

4.18.3 OUTSIDE PLANT PROXIMITY TO OTHER UTILITIES

The vertical and horizontal separation requirements for outside plant telecommunications pathways from other underground utility infrastructure are as follows:

4.18.3.1 Proximity to Power or Other Foreign Conduits

Outside plant telecommunications conduits shall not be installed closer to power conduits or other unidentified underground conduits than:

- 3″ where the surrounding material is concrete
- 4″ where the surrounding material is masonry
- 12″ where the surrounding material is well-tamped earth

4.18.3.2 Proximity to Water, Gas or Oil Conduits

Outside plant telecommunications conduits shall not be installed closer to conduits that can be identified as not containing electrical power distribution conductors than:

- 6″ where the conduits cross
- 12″ where the conduits run in parallel with each other

4.19 PRINCIPLES OF TRANSMISSION

Please refer to the *Principles of Transmission* section of the BICSI TDMM for general information regarding the design of telecommunications distribution infrastructure.

4.20 LOCAL AREA NETWORKS AND INTERNETWORKING

Please refer to the *Local Area Networks and Internetworking* section of the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving local area networks. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at DOC facilities:

A. All DOC facilities use the Ethernet LAN protocol. Telecommunications infrastructure for all DOC facilities shall be designed, installed, and tested to support the Institute of Electrical and Electronic Engineers (IEEE) Ethernet 802.3 standards. DOC IT is in the process of migrating to the 1000Base-X Gigabit Ethernet protocol based on the IEEE 802.3z standard. All newly installed cabling shall support this protocol. The Designer shall give careful consideration to the multimode fiber optic distance limitations and signal loss limitations (less than 2.5 dB end-to-end) necessary to support the IEEE 802.3z protocol.

B. DOC networks are typically based on Cisco switches, with 1GB backbones and 100MB service to the work area. The Designer shall coordinate with the DOC IT Infrastructure Specialist to determine the requirements for supporting the network electronics in each space. The design shall include the infrastructure for hosting this equipment.

C. Media converters shall not be used in DOC installations.

4.21 BUILDING AUTOMATION SYSTEMS

Please refer to the *Building Automation Systems* section of the BICSI TDMM for information regarding the design of telecommunications infrastructure to support building automation systems at DOC facilities.

4.22 PRIVATE CATV DISTRIBUTION SYSTEMS

Please refer to the *Private CATV Distribution Systems* section of the BICSI TDMM for information regarding the design of telecommunications infrastructure to support private CATV distribution systems at DOC facilities.

4.23 OVERHEAD PAGING SYSTEMS

Please refer to the *Overhead Paging Systems* section of the BICSI TDMM for information regarding the design of telecommunications infrastructure to support overhead paging systems at DOC facilities.

4.24 WIRELESS AND MICROWAVE SYSTEMS

Please refer to the *Wireless and Microwave Systems* section of the BICSI TDMM for information regarding the design of telecommunications infrastructure to support wireless and microwave communications systems at DOC facilities.

5 CONSTRUCTION DOCUMENT CONTENT

A. This section of the TDDG describes the content requirements that the Designer shall include when creating the Construction Documents[6]. This content is in addition to the content found in some generally accepted document sets.

B. DOC's philosophy with respect to Construction Documents is that a fully detailed and coordinated design (rather than making adjustments in the field during construction) should result in reduced construction costs and fewer change orders. The level of detail required to meet this objective may be substantially greater than some telecommunications designers may be accustomed to providing.

C. The Designer shall include the following content in the Construction Documents:

5.1 PLANS AND DIAGRAMS

5.1.1 GENERAL

A. The drawing set shall include the following:
- Cover Sheet
- Sheet List
- Site Map
- Symbol Schedule
- List of Abbreviations

B. All plan sheets shall be scaled, shall indicate the scale and shall show a north arrow. All plan sheets shall show a key plan when the building or site is too big to fit on a single sheet.

5.1.2 OUTSIDE PLANT TELECOMMUNICATIONS SITE PLAN DRAWINGS

A. Provide drawings showing a scaled telecommunications distribution site plan. These drawings shall show the following:
- Maintenance hole or handhole locations (labeled with their identifiers)
- Maintenance hole or handhole details
- Complete ductbank routing, details and elevations
- Section cuts
- Existing and new surface conditions

[6] As of this writing, the *Conditions of the Agreement* and the *Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services* (both published by the Washington State Department of General Administration) make reference to the term "Construction Documents." However, the *Manual of Practice* from the Construction Specifications Institute (CSI) defines "Construction Documents" as a subset of the "Construction Documents" and indicates that drawings, specifications and other written documentation are contained within the Construction Document subset. The TDDG will use the term "Construction Documents" according to CSI's definition.

- Outside plant telecommunications cabling

B. These sheets should also identify coordination arrangements where possible conflicts could arise with site work for other disciplines, in particular indicating the separation distances between telecommunications and power or steam. The sequencing of site work also should be shown, if applicable.

C. The site plan shall show the cabling from the service providers (cable television, telephone, etc.) and shall indicate the requirements for owner-provided maintenance holes or handholes and pathway to the point of demarcation.

5.1.3 INSIDE PLANT TELECOMMUNICATIONS PLAN DRAWINGS

A. Scaled plan drawings shall be provided for each building showing the horizontal and intra-building backbone telecommunications infrastructure. These drawings shall show the following:
- Routing of new pathway to be constructed during the project (the information on the drawings shall be coordinated with other disciplines and shall be representative of the actual route that the Contractor shall use, rather than a schematic depiction).
- Approximate locations of junction boxes and conduit bends.
- The size of each junction box.
- The cable quantities and the raceway at any given point in the system.

B. Where new cabling will be pulled into existing homerun conduits, it is desirable but not required to show on the drawings the route of each *existing* homerun conduit, unless the Contractor will encounter unusual conditions. The Designer shall have identified such conditions during the Fieldwork phase.

5.1.4 TELECOMMUNICATIONS ROOM PLAN DETAILS

Construction drawings for DOC projects shall show scaled plan details for the telecommunications spaces. The details shall show the footprint and location of each of the major components in the room including at least the following:

- Backboards
- Ladder Racking
- Work Area
- Grounding Busbar
- UPS Equipment
- Backbone Cable Routing
- Entrance Conduits
- Space for Future Racks
- Termination Blocks
- PBX and Voice Mail
- Inmate Phone Equipment
- Entrance Protection Equipment
- Racks and Vertical Cable Mgmt
- Space for other low voltage systems
- Space Reserved for Utility Demarc

5.1.5 INTRA-BUILDING BACKBONE ELEVATION DIAGRAMS

A. Most DOC buildings are of a size and structure that requires only one TR per building. Where there are multiple TRs in a given building, DOC requires that each TR have a dedicated fiber optic backbone cable connecting it to the ER.

B. An intra-building backbone riser diagram is required where copper backbone cable for voice is to be distributed between multiple TRs within a building. An intra-

building backbone riser diagram is also required for fiber optic backbone cable is distributed among multiple TRs within multistory buildings. In these cases, the Designer shall include an intra-building backbone riser diagram showing new cabling as well as existing cabling and pathway (both to remain and to be removed) in proximity to the new cabling.

5.2 PROJECT MANUAL

A. The *Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services* (published by the Washington State Department of General Administration) lists requirements for the Project Manual. The *State of Washington Conditions of the Agreement* (also published by the Washington State Department of General Administration) lists additional requirements for the Designer.

B. In addition to these requirements, the Project Manual shall contain the following items as described below:
- Maintenance Hole/Handhole Butterfly Diagrams
- Elevation Diagrams
- Cutover Plans
- Cable Records
- Fiber Link-Loss Budget Analyses.

C. The Project Manual shall also contain a summary of the telecommunications work on the project, a description of the demolition requirements (if applicable), and a discussion of the utility coordination requirements.

5.2.1 SPECIFICATIONS

5.2.1.1 DOC Telecommunications Construction Guide Specification

A. The DOC Telecommunications Construction Guide Specification (TCGS) is a *guide* specification as opposed to a *master* specification. It does not include an exhaustive listing of all possible products or installation methods that could be employed in a telecommunications infrastructure project.

B. The TCGS is a specification that shall be used for an infrastructure replacement project or for a new facility project. It has verbiage that identifies issues that the Designer shall consider throughout the adaptation process. The Designer shall adapt the sections in the TCGS to the particular requirements of the given project in producing a CSI-compliant specification. The Designer shall not create a new specification section based on the "intent" of the TCSG or cut and paste content from the TCSG sections into other existing specification sections.

C. The Designer shall directly edit the TCGS for use on each project. The Designer shall notify the DOC IT Infrastructure Specialist where changes or additions to the specifications are desired. Edits to the documents shall be performed with the

"Revision Tracking" features activated. At the various project milestones when the documents are submitted to DOC for review, the specifications shall be printed showing the revision markings.

D. The Designer shall be responsible for adding any necessary content to the specification that is applicable to the project and not already contained in the TCGS.

E. Please refer to the more detailed instructions contained in the TCGS, both in the Preface of that document as well as in the "hidden text" contained in the electronic files.

5.2.2 MAINTENANCE HOLE/HANDHOLE BUTTERFLY DIAGRAMS

A. Butterfly diagrams are a combination of tabular information and schematic diagram used to organize and communicate information related to the conduits and cabling in each maintenance hole and handhole.

B. The Designer shall provide a set of butterfly diagrams depicting each maintenance hole or handhole affected by the project and showing new cabling as well as existing cabling to remain in the maintenance hole or handhole.

C. A second set of butterfly diagrams shall be provided for each maintenance hole or handhole that contains existing cabling intended to be demolished under the project.

D. Typically, butterfly diagrams shall be provided on 8½ x 11"-sized sheets in the Project Manual. However, it may be desirable to show this information on large-format drawing sheets.

E. The diagrams shall be formatted as shown in the sample butterfly diagram in Appendix 6.2. Upon request, DOC will provide an electronic AutoCAD file of this diagram to be used as a template.

5.2.3 ELEVATION DIAGRAMS

A. The Designer shall provide scaled wall elevation details for each TR and ER affected by the project. The Designer should consider (on a project-by-project basis) whether the plan drawings are better suited for depicting the elevation diagrams, in lieu of the Project Manual.

B. The Designer shall produce digital photographs of each wall depicting the existing conditions where future TRs and ERs will be located. These photos shall be provided with the wall elevation details in the Construction Documents.

C. The wall elevation details shall show the components that are mounted on the walls in the room including at least the following:

- Backboards
- Ladder Racking
- Cable Slack Loops
- Grounding Busbar
- Existing Devices
- Work Area
- UPS
- Entrance Pit
- Backbone Cable Routing
- Cable Management
- Termination Blocks
- Power Receptacles
- Entrance Conduits
- Space for Future Racks
- PBX and Voice Mail
- Wall-mounted Electronic Equipment
- Wall-mounted Swing Racks and Contents
- Racks and Vertical Cable Mgmt
- Entrance Protection Equipment
- Inmate Phone Equipment
- Other low voltage systems
- Space for Future Equipment
- Space Reserved for Utility Demarc

D. These details shall also show elevation details for the telecommunications racks in each TR and ER. The rack elevation details shall show the racks and any components that are mounted on or near the racks including at least the following:

- Patch Panels
- UPS Equipment
- Existing Devices
- Shelves / Drawers
- Termination Blocks
- Power Receptacles
- Space for Future Equipment
- Electronic Equipment
- Cable Management

E. The details shall depict the telecommunications materials that are listed in the specification.

F. Where a project involves additions to existing racks, the elevation details shall show the existing equipment in the racks and indicate which items are existing, in addition to indicating which items are "new, to be provided under the Contract".

G. See Appendix 6.4 for an example of a rack and wall elevation detail.

5.2.4 CUTOVER PLAN

A. The Designer shall provide a detailed cutover plan that is coordinated with other disciplines on the project as well as with DOC data and telephone equipment cutover requirements. Verbiage describing the sequence of work and the cutover plan shall be provided in this section. Limitations on the permissible downtime allowed and temporary service arrangements shall be discussed in the cutover plans. The Designer should consider (on a project-by-project basis) whether the plan drawings are better suited for communicating the cutover requirements, in lieu of the Project Manual.

B. For a new campus or a telecommunication infrastructure replacement project, the cutover plan shall show the main telecommunications equipment room (ER / MDF) to be the first facility to be made accessible to DOC to allow time for telephone and network equipment to be installed, configured, tested and activated.

C. Typically, elevation details shall be provided on 8½ x 11"-sized sheets in the Project Manual. However, it may be desirable to show this information on large-format drawing sheets.

D. The cutover plan shall include allowance for DOC to make partial use of the telecommunications infrastructure prior to substantial completion so that DOC IT

staff can start up and configure their equipment in preparation for cutover. The schedule for these activities shall be coordinated during the design process with the DOC IT Infrastructure Specialist and then revisited with the Contractor during construction.

E. See Appendix 6.4 for an example of a cutover plan (combined with the rack and wall elevation detail).

5.2.5 CABLE RECORDS

The Designer shall prepare cabling records (included in the Construction Documents) showing the following information for each of the cable links on the project, and referencing the label identifiers for the project as specified below. The header of the table will show the following fields for each record:

5.2.5.1 Copper Cable

- Cable Identifier
- End locations of cable (ER and/or TR ID)
- Link Type (i.e. backbone, riser, horizontal)
- Media type
- Proposed usage (i.e.: voice, data, lighting control . . . paging)
- As-designed values for link length.
- As-constructed values for link length and headroom (to be recorded by installation contractor based on final test results).

5.2.5.2 Fiber Optic Cable

- Cable Identifier
- End locations of cable (ER and/or TR ID)
- Link Type (i.e. backbone, riser, horizontal)
- Media type (MM, SM)
- Proposed usage (i.e.: voice, data, lighting control . . . paging)
- As-designed values for link length, link attenuation at design frequency (indicate frequency used for design calculations), splice loss, connector loss and calculated link loss.
- As-constructed values (to be recorded by installation contractor based on final test results) for link length and link attenuation (measured link loss) as tested with test frequency.

See Appendix 6.5 for an example of a cable record form. Upon request, DOC will provide an electronic spreadsheet of this form to be used as a template.

5.2.6 FIBER LINK-LOSS BUDGET ANALYSIS

A. The Designer shall provide (in the Construction Documents) a link-loss budget analysis for each strand of fiber.

B. The link-loss budget analysis shall be formatted as shown in Appendix 6.6. Upon request, DOC will provide an electronic spreadsheet file to be used as a template.

5.3 RECORD DRAWINGS AND DOCUMENTATION

The *Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services* (published by the Washington State Department of General Administration) lists requirements for Record Drawings and submittals. The following requirements related to Record Drawings and submittals are in addition to the requirements listed in *Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services*:

- The Record Drawings shall show the identifiers for the telecommunications infrastructure components as constructed.
- One set of 8½x11″-sized butterfly diagrams on bond media shall be delivered to DOC Capital Planning and Development (CPD).
- One CDROM containing the digital photographs taken by the Designer during the project shall be delivered to DOC Capital Planning and Development (CPD).

6 APPENDIX

6.1 SAMPLE REVIEW COMMENT REPORT

The following page shows an example Review Comment Report form that will be used. The Designer shall respond to the comments on this report in the column provided and submit the completed report form to DOC electronically. Upon request, DOC will provide an electronic document for this form to be used as a template.

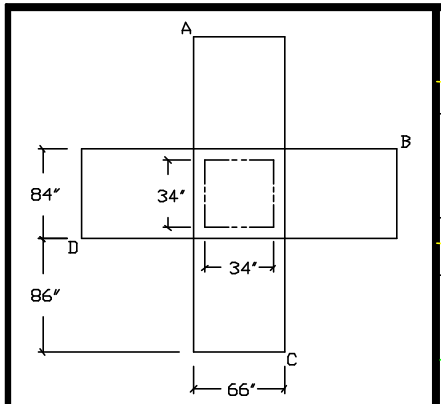
Project # - Project Name - Project Phase Date

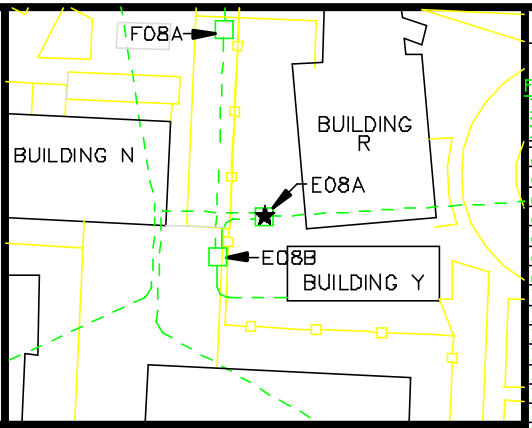
REFERENCE	REVIEWER'S COMMENTS	DESIGNER'S REPLY (ACCEPT/REJECT/COMMENT)	FINAL RESOLUTION (ACCEPT/REJECT/COMMENT)
GENERAL	COMMENTS... SUGGESTIONS... WITH REFERENCES TO APPLICABLE TDDG PARAGRAPHS	ACCEPT	
SPEC SECTION #	COMMENTS... SUGGESTIONS... WITH REFERENCES TO APPLICABLE TDDG PARAGRAPHS	SUGGEST ANOTHER ALTERNATIVE...	
DRAWING SHEET #	COMMENTS... SUGGESTIONS... WITH REFERENCES TO APPLICABLE TDDG PARAGRAPHS	REJECT PER TDDG PARAGRAPH #...	

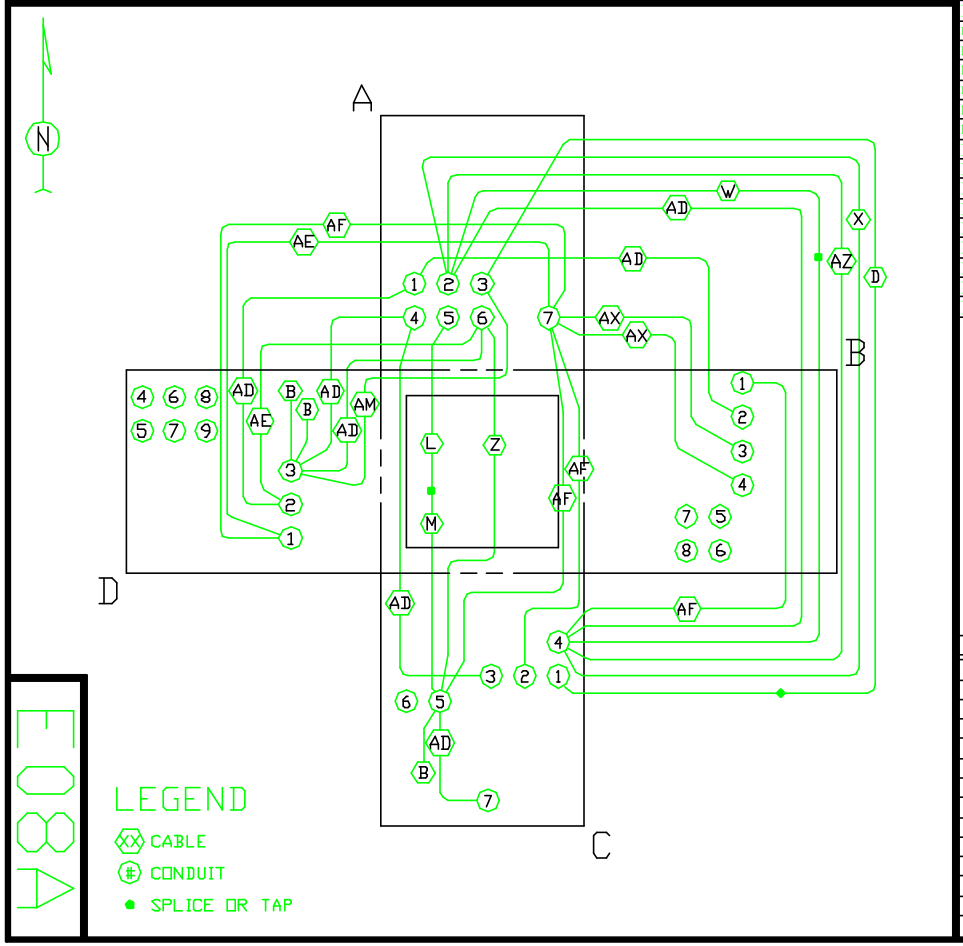
Page #

6.2 SAMPLE BUTTERFLY DIAGRAM

The following page shows a sample maintenance hole / handhole Butterfly Diagram. The Designer shall follow this format and produce a butterfly diagram for each existing maintenance hole or handhole that is affected by an outside plant communications project. The Designer shall submit the completed diagrams to DOC in both electronic and paper forms. Upon request, DOC will provide an electronic AutoCAD file to be used as a template.







CONDUIT CONTENTS

FROM WALL	FROM DUCT	DIAMETER	MATERIAL	CONTENTS	PULL STR.	DESTINATION PULLHOLE/BUILDING	DESTINATION WALL	DESTINATION DUCT	LENGTH
A	1	4	PVC	AD,AD(16)	Y	G08A	C	9	189
A	2	4	PVC	AD(2),W,X,AZ	N	G08A	C	8	189
A	3	4	PVC	D,AM	Y	G08A	C	7	189
A	4	4	PVC	AD(2),AD(4)	N	G08A	C	13	189
A	5	4	PVC	L	Y	G08A	C	12	189
A	6	4	PVC	AE,AD(8),Z	Y	G08A	C	11	189
A	7	2	PVC	AF,AE,AX,AX,AF,AF	Y	G08A	C	10	189
B	1	2	PVC	AF	Y	BUILDING Y ("1A")	B	1	310
B	2	2	PVC	AD	Y	BUILDING Y ("1A")	B	2	310
B	3	2	PVC	AX	N	BUILDING Y ("1A")	B	3	310
B	4	2	PVC	AX	N	BUILDING Y ("1A")	B	4	310
B	5	4	PVC	-	N	UNKNOWN (X)	X		
B	6	4	PVC	-	N	UNKNOWN (X)	X		
B	7	4	PVC	-	N	UNKNOWN (X)	X		
B	8	4	PVC	-	N	UNKNOWN (X)	X		
C	1	4	PVC	D	N	BUILDING S ("1A")	D	3	370
C	2	4	PVC	AF	N	BUILDING S ("1A")	D	2	370
C	3	4	PVC	AD(2)	Y	BUILDING S ("1A")	D	1	370
C	4	4	PVC	AF,AD(2),W,AZ,X	N	BUILDING S ("1A")	D	4	370
C	5	4	PVC	AD,B,AF,Z,M,L	Y	BUILDING N ("1A")	C	2	260
C	6	4	PVC	-	Y	BUILDING N ("1A")	D	3	260
D	1	4	PVC	AF,AE	Y	BUILDING N ("1A")	A	3	260
D	2	4	PVC	AD(16),AE	N	BUILDING N ("1A")	B	1	260
D	3	4	PVC	B,B,AD(4),AD(8),AM	N	BUILDING N ("1A")	A	4	260
D	4	4	PVC	-	Y	E08B	A	15	135
D	5	4	PVC	-	Y	E08B	A	16	135
D	6	4	PVC	-	Y	E08B	A	17	135
D	7	4	PVC	-	Y	E08B	A	18	135
D	8	4	PVC	-	Y	E08B	A	19	135
D	9	4	PVC	-	Y	E08B	A	20	135

CONTENT INDEX

I.D.	MATL.	DIA.	DESCRIPTION
AD	COPPER	0.16	FIRE/DOOR ALARM
AE	COPPER	0.14	GATE/LIGHTING CONTROL
AF	COPPER	0.11	HVAC/IC
AM	COAX	0.26	COAX
AX		1.25	INNERDUCT (NOT VACANT)
AZ			OTHER/UNKNOWN
B		1.25	VACANT INNERDUCT
D	COPPER	2.45	600 PAIR TO S,X,U,W,PPPP,H
L	COPPER	1.92	300 PAIR TO N,O,P
M	COPPER	1.24	200 PAIR TO N,O,P
W	FIBER	0.58	72 STRAND M/M TO X,U,W,H
X	FIBER	0.27	12 STRAND M/M TO S
Z	FIBER	0.27	12 STRAND M/M TO O

E08A

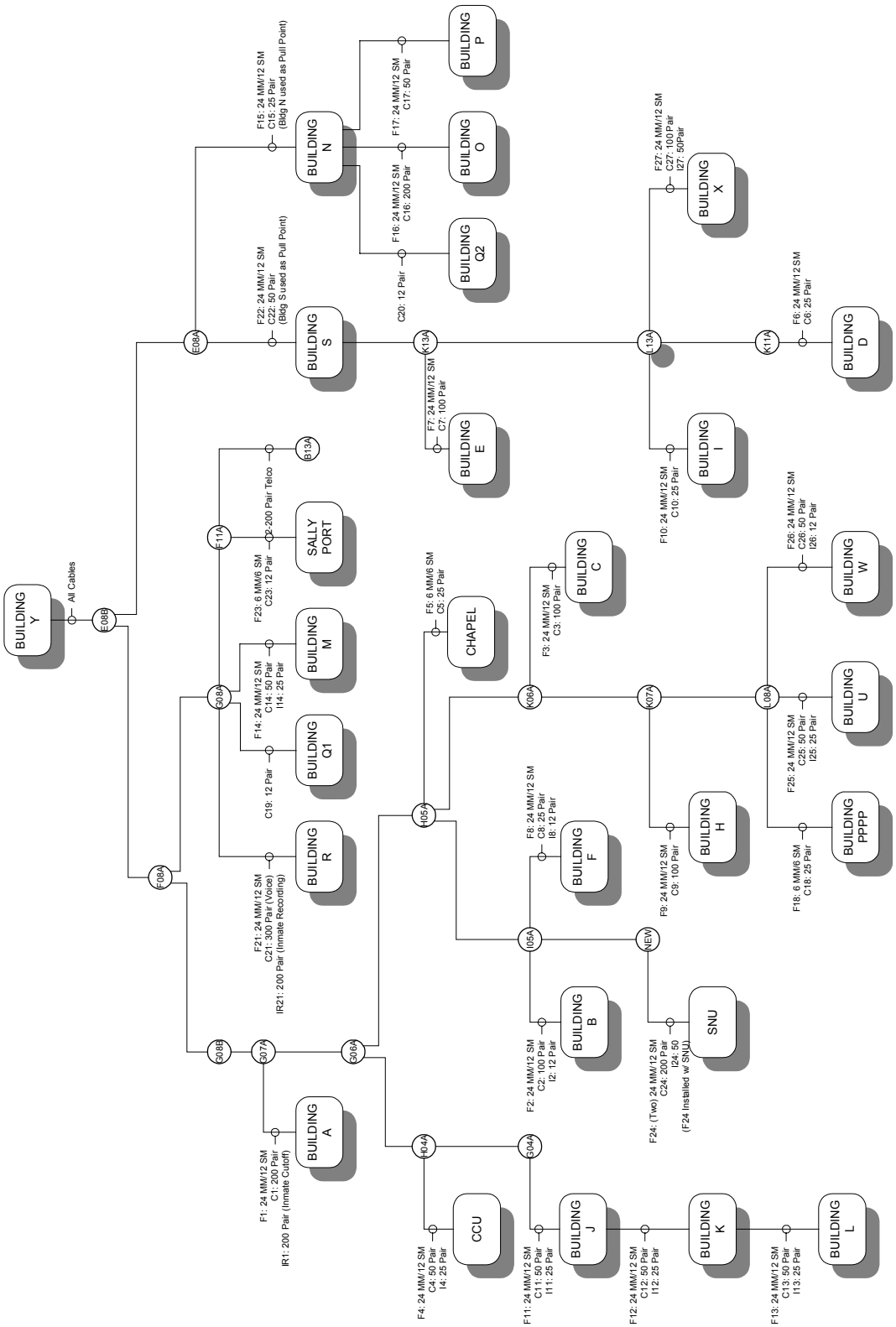
NAME OF SITE

WASHINGTON STATE
DEPT. OF CORRECTIONS

6.3 SAMPLE BACKBONE SCHEMATIC DIAGRAM

The following page shows a sample Backbone Schematic Diagram. The Designer shall follow this format and produce backbone schematic diagram for each project that includes new outside plant communications infrastructure.

Backbone Schematic Diagram



6.4 SAMPLE COMBINATION RACK/WALL ELEVATION DETAIL WITH CUTOVER PLAN

The following page shows a sample elevation detail combining rack and wall elevations with a cutover plan for an existing telecommunications room.

The Designer shall provide similar information for each new or existing telecommunications room and new or existing equipment room affected by the project.

This information shall be provided either as a portion of the Project Manual or on the drawings, and shall be considered part of the Construction Documents.

BUILDING ZZZ - MAIN TELECOMMUNICATIONS ROOM "1A"

FIGURE 1. EXISTING WEST WALL COMMUNICATIONS BACKBOARD

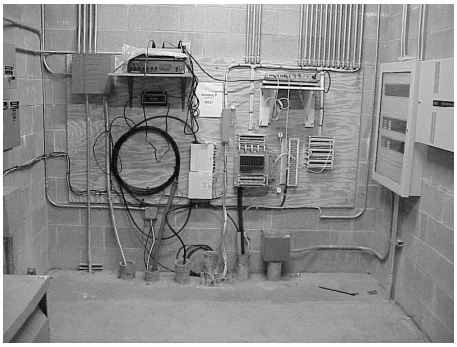
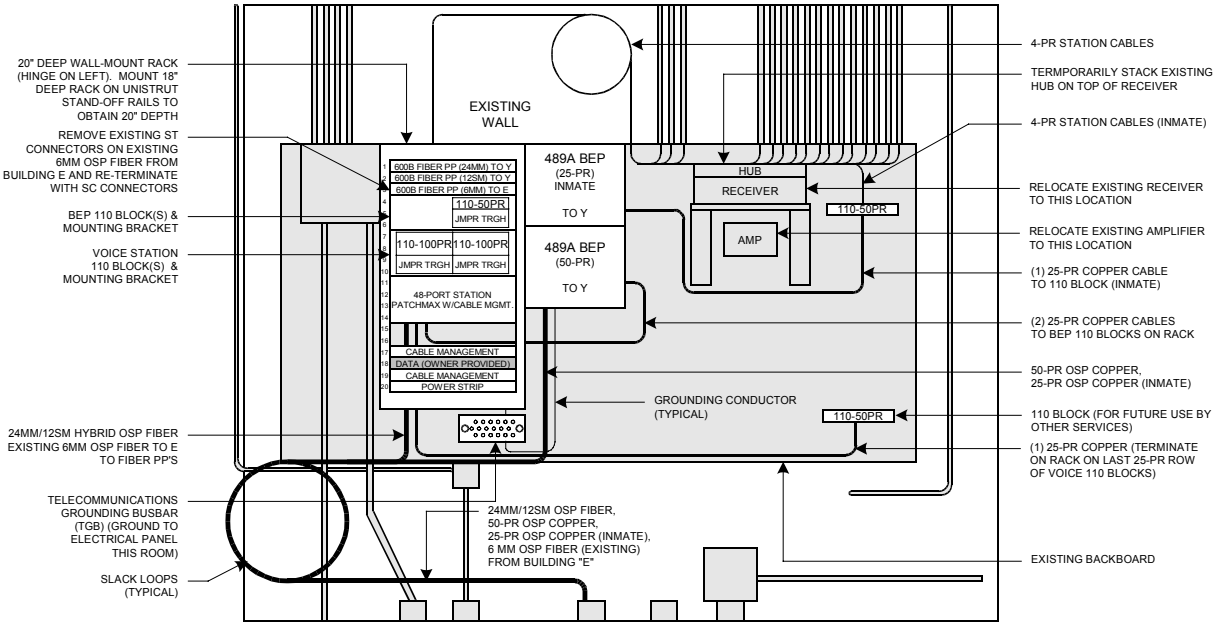


FIGURE 2. REVISED WEST WALL COMMUNICATIONS BACKBOARD (1/2" = 1')
(GRAYED-OUT EQUIPMENT IS EXISTING TO REMAIN OR PROVIDED BY OTHERS)



PHASING/CUTOVER NOTES:

PRIOR TO PROCEEDING WITH CONSTRUCTION FOR THIS BUILDING, REFER TO THE NOTES IN "GENERAL BUILDING PHASING/CUTOVER NOTES" FOR ADDITIONAL AND IMPORTANT GENERAL NOTES WHICH APPLY TO THIS BUILDING AND TO EACH OF THE PHASES BELOW.

PHASE 1 - PROVIDE NEW CAMPUS BACKBONE MATERIALS AND EQUIPMENT

THIS CLOSET WILL SERVE AS THE MAIN (AND ONLY) COMMUNICATIONS CLOSET FOR THE BUILDING. DETACH EXISTING CAMPUS BACKBONE OSP CABLES AND EXISTING STATION CABLES AND SUPPORT AWAY FROM THE BACKBOARD ENSURING THAT ALL EQUIPMENT AND CABLES REMAIN FULLY FUNCTIONAL. RELOCATE EXISTING RECEIVER TO SAME SHELF AS EXISTING DATA EQUIPMENT (STACK DATA EQUIPMENT ON TOP OF RECEIVER) AND EXISTING AMPLIFIER UNDERNEATH SHELF TO LOCATION SHOWN, ENSURING THAT ALL EQUIPMENT AND CABLES REMAIN FULLY FUNCTIONAL. DEMOLISH EXISTING AMPLIFIER SHELF. DEMOLISH EXISTING 66-BLOCK AND ASSOCIATED CABLES IN MIDDLE OF BACKBOARD NO LONGER IN USE. PROVIDE NEW EQUIPMENT, CABLE, MATERIALS, AND ANY INCIDENTALS IN LOCATIONS SHOWN. BOND ALL NON-CURRENT CARRYING METAL EQUIPMENT AND MATERIALS TO THE TGB WITH GROUNDING CONDUCTOR. INSTALL NEW CAMPUS BACKBONE OSP COPPER AND FIBER CABLES AND ENSURE THAT DURING INSTALLATION THE EXISTING CABLES ARE NOT DAMAGED OR DISCONNECTED. ENSURE THAT ADEQUATE CABLE SLACK EXISTS AND IS SECURED SUCH THAT THE RACK MAY BE SWUNG OPEN WITHOUT PINCHING, DISCONNECTING, OR OTHERWISE STRESSING THE CABLES. ONCE THE NEW FIBER PATCH PANELS ARE INSTALLED, REMOVE THE EXISTING 6MM FIBER CABLE FROM BUILDING E FROM THE EXISTING FIBER PATCH PANEL AND RE-TERMINATE ON THE NEW FIBER PATCH PANEL SHOWN USING SC CONNECTORS. TEST ALL CABLES PER SPECIFICATIONS.

PHASE 2 - DEMOLISH EXISTING STATION CABLING/INSTALL NEW STATION CABLING

INSTALL STATION CABLING IN RACK IN SUCH A WAY AS TO ENSURE THAT ADEQUATE CABLE SLACK EXISTS AND IS SECURED SUCH THAT THE RACK MAY BE SWUNG OPEN WITHOUT PINCHING, DISCONNECTING, OR OTHERWISE STRESSING THE CABLES. FOR EXISTING STATIONS WITH IN-USE (ACTIVE) PORTS, INSTALL TEMPORARY CROSS-CONNECTS AS DETAILED IN "GENERAL BUILDING PHASING/CUTOVER NOTES - PHASE 2."

PHASE 3 - CAMPUS BACKBONE CUTOVER

REMOVE THE TEMPORARY CROSS-CONNECTS AND CROSS-CONNECT THE VOICE AND INMATE PHONE STATIONS TO THE NEW CAMPUS COMMUNICATIONS CABLING (COPPER)

6.5 SAMPLE CABLE RECORD

The following page shows an example Cable Record that the Designer shall use for recording information about each cable that is installed during a project. The Designer shall submit the completed cable records to DOC in both electronic and paper forms. Upon request, DOC will provide an electronic document for this form to be used as a template.

Sample Cable Record

Cable Identifier (ID):			
End Location ID:		**End Location ID:**	
Link Type:	☐ Campus ☐ Intra-Building Backbone ☐ Riser ☐ Horizontal		
Media Type:	☐ MM ☐ CAT3 ☐ CAT5 ☐ SM ☐ CAT5e ☐ CAT6	# of Conductors	☐ Strands ☐ Pairs
General Usage:	☐ Voice ☐ Data ☐ Video ☐ Other: _____		
# Pairs/Strands In Use:			
# Damaged PRs/STDs:			
# Available PRs/STDs:			

As Designed (Calculated):		
Cable Length:		ft
(Fiber) Splice Loss:	Attenuation:	dB
(Fiber) Connector Loss:	Attenuation:	dB
(Fiber) Link Attenuation:	Attenuation:	dB at Wavelength: nm
(Fiber) Link Loss:	Attenuation:	dB

As Constructed (Measured):	
Cable Length:	ft
(Copper) Headroom:	dB

Pair / Std #	Link Loss (Fiber)	Usage Description	Pair / Std #	Link Loss (Fiber)	Usage Description
1			25		
2			26		
3			27		
4			28		
5			29		
6			30		
7			31		
8			32		
9			33		
10			34		
11			35		
12			36		
13			37		
14			38		
15			39		
16			40		
17			41		
18			42		
19			43		
20			44		
21			45		
22			46		
23			47		
24			48		

Comments:

6.6 SAMPLE FIBER OPTIC LINK-LOSS BUDGET ANALYSIS

The following page shows an example Fiber Optic Link-Loss Budget Analysis that the Designer shall use for each new fiber optic cable designed in the project. The Designer shall submit the completed link-loss budget analyses to DOC in both electronic and paper forms. Upon request, DOC will provide an electronic spreadsheet of this form to be used as a template.

Fiber Optic Link Loss Budget

Cable ID: ***cable identifier***
From: ***Building A***
To: ***Building B***

			MM 850		MM 1300		SM 1310		SM 1550	
Passive Cable System Attenuation										
Fiber Loss at Operating Wavelength	Cable Length (in kilometers)									km
	x Attenuation per km	x	3.40	x	1.00	x	0.40	x	0.30	dB/km
	= **Total Fiber Loss**									dB
Connector Loss	Number of Connector Pairs									pairs
(Excluding Tx & Rx Connectors)	x Individual Connector Pair Loss	x	0.30	x	0.30	x	0.30	x	0.30	dB/pair
	= **Total Connector Loss**									dB
Splice Loss	Number of Splices									splices
	x Individual Splice Loss	x	0.15	x	0.15	x	0.20	x	0.20	dB/splice
	= **Total Splice Loss**									dB
Other Components Loss	**Total Components Loss**									dB
Total Passive Cable System Attenuation	Total Fiber Loss									dB
	+ Total Connector Loss	+		+		+		+		dB
	+ Total Splice Loss	+		+		+		+		dB
	+ Total Components Loss	+		+		+		+		dB
	= **Total System Attenuation**									dB

			MM 850		MM 1300		SM 1310		SM 1550	
Link Loss Budget										
From Manufacturer's Specifications	Average Transmitter Output		-18.0		-18.0		-18.0		-18.0	dBm
	Receiver Sensitivity (10^9 BER)		-31.0		-31.0		-31.0		-31.0	dBm
System Gain	Average Transmitter Power		-18.0		-18.0		-18.0		-18.0	dBm
	- Receiver Sensitivity	-	-31.0	-	-31.0	-	-31.0	-	-31.0	dBm
	= **System Gain**	=	13.00	=	13.00	=	13.00	=	13.00	dB
Power Penalties	Operating Margin		2.0		2.0		3.0		3.0	dB
# of Fusion Splices Loss per Splice	+ Receiver Power Penalties	+	0.0	+	0.0	+	0.0	+	0.0	dB
2 X 0.3 =	+ Repair Margin	+	0.6	+	0.6	+	0.6	+	0.6	dB
	= **Total Power Penalties**	=	2.60	=	2.60	=	3.60	=	3.60	dB
Link Loss Budget	System Gain		13.00		13.00		13.00		13.00	dB
	- Power Penalties	-	2.60	-	2.60	-	3.60	-	3.60	dB
	= **Total Link Loss Budget**	=	10.40	=	10.40	=	9.40	=	9.40	dB

			MM 850		MM 1300		SM 1310		SM 1550	
Performance										
System Performance Margin	Link Loss Budget		10.40		10.40		9.40		9.40	dB
	- Passive Cable System Attenuation	-		-		-		-		dB

6.7 GLOSSARY

ANALOG

Analog comes from the root word "analogous," which means "similar to." In telecommunications, analog is a way of sending signals—voice, data, or video—in which the transmitted signal is analogous to the original signal. In other words, if you spoke into a microphone and saw your voice on an oscilloscope took the same voice as was transmitted on the phone line and viewed that signal on an oscilloscope, the two signals would look the same. See Digital.

AWG (AMERICAN WIRE GAUGE)

The standard measuring gauge of the diameter of copper wires in telecommunications and electrical cables.

BACKBOARD

A plywood sheet mounted to the wall where telecommunications distribution equipment is installed. The backboard must be three-quarter (¾)-inch thick A-C grade plywood, mounted with the "A" side exposed. The backboard must be coated with two coats of light colored, non-conductive fire retardant paint.

BACKBONE CABLING

Backbone cable is defined as a major service cable that is used to interconnect various buildings on a campus, connect equipment rooms to telecommunications closets within a building, or connect one telecommunications closet to another within the same building. Backbone cables are typically large capacity (high pair-count) copper cables, or fiber optic cables.

BEND RADIUS

The maximum radius that a cable can be bent to avoid physical or electrical damage or cause adverse transmission performance.

BONDING

The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely to ground any current likely to be imposed.

BUS

An electrical connection which allows two or more wires to be bonded together.

BUSBAR

A copper bar, drilled and tapped, to allow the bonding together of wires or cables.

CABLE PAIR

Each telecommunications circuit is made up of two copper wires, or a pair of wires. Traditional analog telephone service uses one-pair of wires. Some modern digital telephone systems, and most computer networks operate over two or four pairs of wires. The ANSI/TIA/EIA-568-A standard requires a four-pair cable to each work-area information outlet.

CABLE PLANT

A term which refers to the physical connection media such as optical fiber cable or copper cable. See Telecommunications Infrastructure.

CABLE PULL TENSION

Stated by the manufacturer as the maximum limit at which the cable's performance characteristics are altered, experiencing electrical or mechanical degradation. Also known as maximum recommended installation load (MRIL).

CABLE TENSILE STRENGTH

Is the limit point where the cable is pulled apart.

CHANGE ORDER (CO)

Change Orders document the modifications to an existing contract. The change order procedure can be initiated by the Owner, Contractor, or the A/E. The A.E will generally start the process using the Change Order/Change Order Proposal form.

CAMPUS

The buildings and grounds of a complex or facility.

CATV (COMMUNITY ANTENNA TELEVISION)

CATV is commonly referred to as "cable TV." In the traditional sense, CATV is a master antenna that receives television signals, and distributes the signal over cables to a limited geographical area, such as a campus, or neighborhood (community). Some DOC facilities receive cable TV service from a local service provider for a subscription fee. Other DOC facilities have their own TV antennas, including satellite antennas, and distribute the signals throughout the facility over fiber optic and/or copper cables.

CCTV (CLOSED CIRCUIT TELEVISION)

CCTV is a system where one or more cameras send a television signals to television monitors at another location in the same building or campus. DOC commonly uses CCTV for security monitoring at strategic locations, with TV monitors located in officer's stations or control booths.

CORRECTIONAL INDUSTRIES (CI)

Correctional Industries (CI) buildings are facilities located at a corrections institution where certain private companies or industries on contract to the state can utilize an inmate labor force to produce goods and materials. The goods and materials are then made available for sale to state and local government agencies. CI buildings have additional unique requirements for telecommunications systems.

1. The systems must be protected from unauthorized inmate access, since CI buildings are normally within the Secured Area. See Secured Area.
2. The private companies who operate in CI buildings are on fixed duration contracts. When the contract expires, it is likely that another company, with different telecommunications needs, will use the CI buildings. Therefore, the telecommunications infrastructure must be designed to be flexible.
3. The private companies who operate in CI buildings will be responsible for their own telecommunications services, including purchasing and installing telephone service and any data services required by the company.
4. Since the DOC owns the CI buildings, the DOC will provide the basic telecommunications infrastructure, designed and sized to support the basic function of the building.

CROSS-CONNECT (XC)

A cross-connect, or cross-connection, is where individual cable pairs from two different cables are connected together with jumper wires. An XC is intended to be easily reconfigured, as opposed to a cable splice which is permanent.

DATA SERVICES

Data service generally refers to the computer network. For future planning purposes, data shall be considered to be any information that is transferred in digital form. Advances in technology are blending together traditional voice, data, and video services. Eventually, a single telecommunications system may process all forms of telecommunications (voice, data, and video) over a common infrastructure.

DEMARC

The point of demarcation between the service provider and the customer. The demarc is actually a cable termination block with an orange cover where the service provider's cable terminates. The services are then cross-connected to the customer's cable for distribution throughout the facility. See Telecommunications Service Entrance Facility.

DIGITAL

In telecommunications or computing, digital is the use of a binary code to represent information. In binary code, the information is represented by a series of "on" or "off" states (a signal, or an absence of a signal).

Analog signals—like a voice—are encoded digitally by sampling the voice analog signal many times a second and assigning a number to each sample. During transmission, the signals will lose strength and progressively pick up noise or distortion. In analog transmission, the signal (along with any noise that is picked up) is simply amplified to maintain the proper signal strength at the distant end. In digital transmission, the signal is regenerated, cleaning off any noise, and restoring the signal to its original form. Then the signal is amplified, and sent to the destination. At the destination, the digital signal is again regenerated, and restored to its original form for processing. See Analog.

EMI ELECTRO MAGNETIC INTERFERENCE

Electro Magnetic Interference is a signal distortion directly related to a foreign signal being imposed through coupling onto a transmission path that the foreign signal is not physically connected to.

ENTRANCE FACILITY (EF)

See Telecommunications Service Entrance Facility (EF).

ETHERNET 10/100 BASE-TX PIN ASSIGNMENTS

At the outlet Ethernet 10/100 Base-TX uses pins 1 and 2 for transmit and pins 3 and 6 for receive in the associated 4 pair cable. The LAN switch transmits the signal over pair 3 and receives the signal over pair 2. In the jack at the workstation and the patch panel pair 3 is terminated with its tip side on pin 1 and its ring side on pin 2 while pair 2 is terminated with its tip side on pin 3 and its ring side on pin 6. For further information see section 4.3.5.

EXISTING BUILDINGS

The vast majority of telecommunications projects involve installing or upgrading the telecommunications infrastructure in existing buildings in order to make use of new technology. Most buildings older than 15 or 20 years do not have adequate space for equipment rooms, telecommunications closets, or cable routing pathways. Older buildings also usually do not have adequate electrical power to support large quantities of electronics equipment such as computers, copiers, fax machines, etc. Upgrade projects in existing buildings are frequently impacted by inadequate requirements analysis and insufficient funding.

FACILITY CONTROL AND MONITORING

It is becoming increasingly common for heating, ventilation, air conditioning, power distribution, and water distribution systems to be computer controlled. These computer-controlled systems can be networked on the same LAN, or the same telecommunications infrastructure, as the traditional data services.

FIRE AND LIFE SAFETY

As with Facility Control and Monitoring systems, Fire and Life Safety systems such as smoke detectors, sprinkler systems, and fire alarms are increasingly becoming computer controlled and networked. These systems can also communicate over the common telecommunications infrastructure. Local codes may have certain restrictions on the manner in which Fire and Life Safety systems are networked, and shall be consulted prior to system design.

GROUND

A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

GROUNDING, BONDING, AND ELECTRICAL PROTECTION

Proper grounding and bonding serves three very important purposes. First, from a life safety aspect, the ground connection insures that voltages from a malfunctioning system are routed directly to ground to prevent an electrocution hazard to people who may come in physical contact with the system. Secondly, from a telecommunications standpoint, grounding and bonding of telecommunications equipment and systems is an important measure for controlling electromagnetic interference (EMI). Ungrounded systems can pick up energy that is radiated from another electrical source, such as a large electric motor, an arc welder, or a large copy machine. If this energy is absorbed into the telecommunications system, it can result in annoying interference on the signal, or at worst, corruption and loss of critical data. Thirdly, the telecommunications ground may be used as a reference voltage for electronics equipment. The telecommunications ground potential must be consistent to insure reliable system performance.

GROUNDING ELECTRODE

The metallic component that is placed in the earth to form the electrical connection with the earth. A grounding electrode is usually a metal rod at least eight (8)-feet long driven into the earth. Refer to NFPA 70, Article 250, Part H for acceptable electrical service grounding electrodes.

HANDHOLE

A small cast concrete box placed in an outside plant conduit run as an access point to facilitate pulling cable into the conduit.

HEAD END

In a CATV system, the head end is a term that refers to the electronics equipment that receives the television signals from the antennas, and distributes them over the copper and/or fiber optic cables.

HORIZONTAL DISTRIBUTION CABLING (HDC)

Horizontal distribution cable is defined as the cable that routes from the telecommunications closet to the work area. Generally, these cables are routed horizontally on the same floor of a building, as opposed to a backbone or "riser" cable that may route vertically in a building. Occasionally, a telecommunications closet will also serve the floor above and/or below. In this case, the cables routing from the telecommunications closet to a work-area on the floor above or below are still considered to be horizontal distribution cabling.

HUB

An older LAN device that is used as the core of a star distribution to work-area computers. Generally, data service is delivered from the Equipment Room to the Telecommunications Closet over fiber optic cable. The fiber optic cable is connected to a hub. Patch cords connect from the hub to the patch panel to distribute data communications to the work-area computers over copper cable. DOC is migrating from LAN hubs to LAN switches.

IDENTIFIER

A unique descriptive name or number that identifies a specific telecommunications infrastructure component. For example, telephone (voice) wall outlet number 23 would probably have a label with the identifier "V-23."

INFRASTRUCTURE

The ISP and OSP pathways, spaces, cable plant, and associated electronic devices comprising the low voltage signaling systems including but not limited to voice, data, building controls, security etc.

INMATE TELEPHONES

Telephone service for inmate use is provided through a contract with the Local Exchange Carrier and/or Long Distance Carrier. The telecommunications infrastructure to support inmate telephone service is normally part of the overall facility infrastructure, and is owned by the Department of Corrections. Provisions must be made at the Main Cross-connection point or Main Equipment Room to separate inmate telephone services from official DOC services. Provisions are also usually made through the service provider for monitoring and recording of inmate telephone services for security purposes.

INFORMATION OUTLET (IO), (OR OUTLET JACK, OR OUTLET CONNECTOR)

A wiring device used to terminate horizontal distribution cable at the work-area, normally housed in an outlet box. Commonly referred to as an outlet jack, or outlet connector. The IO jack will accept the modular eight (8)-position, eight (8)-conductor plug that is normally installed on the end of a patch cord or equipment cord.

INSIDE PLANT (ISP)

That part of the telecommunications infrastructure that is contained within a building.

INTERMEDIATE CROSS-CONNECT (IC)

A point where a backbone cable originating from the Main Cross-connect (MC) is cross-connected to another backbone cable routing to the final destination. The IC is usually located in a Telecommunications Closet (TC). The IC was previously referred to as the Intermediate Distribution Frame (IDF).

INTERMEDIATE DISTRIBUTION FRAME (IDF)

An obsolete term referring to the Intermediate Cross-connect (IC).

JACK (OR OUTLET JACK)

A wiring device used to terminate horizontal distribution cable, normally housed in an outlet box. See Information Outlet.

JUMPER WIRE

A short length of wire used to route a circuit by linking two cross-connect points.

LOCAL AREA NETWORK- (LAN)

The LAN is the network that interconnects all data services for a building or campus. There may be one or more LANs in any given building or campus.

LOCAL EXCHANGE CARRIER (LEC)

The local telephone company, usually U S WEST Communications, GTE, or PTI.

LUCENT TECHNOLOGIES SYSTIMAX® STRUCTURED CABLING SYSTEM

The Lucent Technologies SYSTIMAX® Structured Cabling System (SCS) is a group of integrated communications cabling products for voice, data, and video networks within a building or campus of buildings. The SYSTIMAX® SCS is comprised of modular components that have been engineered and tested together as a system to deliver optimum performance. The SCS is based on the star wiring topology, using 24-AWG unshielded twisted pair (UTP) copper cable, and multimode and singlemode, graded-index fiber optic cables.

MAIN CROSS-CONNECT (MC)

The Main Cross-connect is the point where all telecommunications services are cross-connected to the building or campus backbone cables for distribution to other buildings, and ultimately, to the users work-area. The MC is usually located in the Main Telecommunications Equipment Room (ER).

MAIN DISTRIBUTION FRAME (MDF)

An obsolete term referring to the Main Cross-connect (MC).

MAIN TELECOMMUNICATIONS EQUIPMENT ROOM (ER)

The Main Telecommunications Equipment Room is the central location on a campus or in a building where the major telecommunications equipment is located. The ER typically contains the telephone switching system, the data center with computer servers and network equipment, the CATV "head end" distribution equipment, or all of these systems. It is preferred that all low voltage systems be centralized in the ER.

MAXIMUM RECOMMENDED INSTALLATION LOAD (MRIL)

Stated by the manufacturer as the cable strength or maximum cable pull tension. It is based on the conductor strength within the cable sheath.

MODULAR JACK

A "female" telecommunications connector that accepts a mated male modular plug.

MODULAR PLUG

A "male" telecommunications connector that is inserted into a mated female modular jack.

MPOP

Minimum-Point-of-Presence. This is a policy statement, where it is generally the service provider's policy to locate the Point-of-Presence (POP) the minimum distance possible in from the street. The service provider usually prefers the POP to be at the street. However, the customer usually prefers the POP to be in the Equipment Room. See POP, Demarc, and Telecommunications Service Entrance Facility.

NEMA

National Electrical Manufacturers Association.

NEW CONSTRUCTION

New construction projects, either for an individual building, or a complete campus, provide an opportunity to properly design the telecommunications substructure, infrastructure, and systems. It is critically important that telecommunications professionals be involved in the early planning and conceptual design of any new construction projects. Anticipating that a new DOC building or facility may have a useful life of 100 years or more, the proper sizing and placement of equipment rooms, telecommunications closets, and telecommunications substructure will have a major impact on the long term utility and cost effectiveness of the building.

NON-SECURED AREAS

Non-secured Areas are defined as those areas where inmates do not normally have routine, unescorted access. Non-secured Areas include buildings outside of the fenced security perimeter of a corrections institution. Community Corrections offices and the DOC Headquarters building are Non-secured Areas. Non-secured Areas generally do not require any unique security precautions to protect the telecommunications systems or infrastructure beyond those that would normally be applied to a similar style building. See Secured Areas.

OUTLET BOX

An enclosure mounted in the wall, or surface mounted on a wall, floor or furniture, into which an information outlet jack may be installed.

OUTLET CONNECTOR (OR INFORMATION OUTLET)

A wiring device used to terminate horizontal distribution cable, normally housed in an outlet box. See Information Outlet.

OUTSIDE PLANT (OSP)

The part of the telecommunications infrastructure that is outside. Usually in an underground conduit system, direct bury cable, or aerial cable.

PATCH CORD

A short length of telecommunications cable with modular plugs on each end used to connect between an Information Outlet and a work-area device such as a telephone or computer, or to connect between a patch panel and an electronics device in the Telecommunications Closet or Equipment Room.

PATCH PANEL

A panel mounted in an equipment rack in the Telecommunications Closet or Equipment Room containing modular jacks. The TC or ER end of the horizontal distribution data cable is terminated at the patch panel. Patch cords are used to connect work-area devices to hubs, routers, or switches located in the TC or ER.

PATHWAY (OR CABLE PATHWAY)

A raceway, conduit, sleeve, or reserved location for the placing and routing of telecommunications cable.

PBX

Private Branch eXchange. A large, full feature telephone switching system that usually serves a large building or campus.

POP

Point-of-Presence. The physical location where a service provider delivers telecommunications service. See MPOP, Demarc, and Telecommunications Service Entrance Facility.

PRIMARY PROTECTOR (OR PROTECTOR BLOCK, OR PROTECTOR PANEL)

A device interconnected to the telecommunications service providers' access line, or to each end of an outside plant campus distribution copper cable, to protect the connected equipment and personnel from over-voltage and/or over-current conditions. Hazardous voltages and currents are shunted to ground through the protector block.

PULLBOX

A box, located in an inside plant cable pathway, intended to serve as an access point to facilitate pulling cable through the conduit.

REGISTERED COMMUNICATIONS DISTRIBUTION DESIGNER (RCDD)

The internationally recognized professional designation of Registered Communications Distribution Designer (RCDD) is presented by BICSI a Telecommunications Association to its members that have proven their ability through on the job experience and having passed a through exam.

RFI

Radio Frequency Interference is a signal distortion directly related to a foreign radio signal being imposed through coupling onto a transmission path that the foreign radio signal is not physically connected to.

RACEWAY

A metal or plastic channel used for loosely holding telecommunications or electrical cables. See Pathway.

RISER CABLE

An obsolete term referring to backbone cable.

ROUTER

A device that connects between two networks, and routes data traffic from one network to the other.

SECURED AREAS

Secured Areas are defined as those areas where inmates are housed, confined, contained, or have unescorted access. The Secured Area is the area within the fenced security perimeter of a corrections institution. Telecommunications systems, information processing systems and telecommunications distribution systems must be protected from unauthorized access or tampering by inmates inside the Secured Area. Special security precautions must be taken for equipment rooms, telecommunications closets, and cable routing pathways inside Secured Areas. See Non-secured Areas.

SECURITY SYSTEMS

Security systems such as intrusion alarms, remote door locks, and magnetic strip identification cards may be computer controlled and networked. Some new technology employs Biometric systems that scan the retina of the eye, or make an optical image of the fingerprint, and compare that image to a computer database as a means of identification. Many of these systems have proprietary components, but many can be networked on the common telecommunications infrastructure and shall be taken into consideration in any design.

SERVICE PROVIDER

The company or utility that provides telecommunications services to a customer.

SNEAK CURRENT

Unwanted but steady currents that seep into a communication circuit. These low-level currents are insufficient to trigger electrical surge protectors and therefore are able to pass them undetected. They are usually too weak to cause immediate damage, but if unchecked will create harmful heating effects. Sneak currents may result from contact between communications lines and AC power circuits or from power induction, and may cause equipment damage due to overheating.

SPLICE

A permanent joining of conductors from separate cables.

SPLICE BOX

A box, located in a pathway, intended to house a cable splice.

SPLICE CLOSURE

A device used to enclose and protect a cable splice.

STAR TOPOLOGY (OR STAR DISTRIBUTION)

A topology where all phones and computers in a given area are wired directly to a central service location in the telecommunications closet. Star topology is the standard wiring topology for the DOC.

SUBSTRUCTURE

The ISP and OSP pathways and spaces for the low voltage signaling systems including but not limited to voice, data, building controls, security etc. Substructure does not include cable plant and electronic devices (see infrastructure).

SWEEP

A conduit bend that meets ANSI/TIA/EIA-569-A bend-radius requirements forming a gentle arc rather than a sharp bend.

SWITCH-LAN

A device that interconnects networked data devices through port-to-port switching.

TELECOMMUNICATIONS

Any transmission, emission, or reception of signs, signals, writings, images, and sounds, or information of any nature by wire, radio, visual, or other electromagnetic systems.

TELECOMMUNICATIONS BONDING BACKBONE (TBB)

The grounding conductor (cable) that interconnects the Telecommunications Main Grounding Busbar (TMGB), Telecommunications Grounding Busbars (TGB), various telecommunications equipment, equipment racks, and cable shields to the building's electrical service grounding electrode.

TELECOMMUNICATIONS CLOSET (TC)

The Telecommunications Closet is a location in each building, or each floor of a building, where backbone cables transition to horizontal distribution cables. The TC may also contain certain items of network electronics equipment such as hubs or routers. A large building, with large floors, may have multiple TCs on a floor. Depending on the size of the building, a TC may be a separate room, or it may be simply be a cabinet containing telecommunications equipment.

TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

In buildings with multiple Telecommunications Closets, each TC is equipped with a TGB. All of the TGBs in the building are bonded together, and to the Telecommunications Main Grounding Busbar (TMGB), with the Telecommunications Bonding Backbone (TBB).

TELECOMMUNICATIONS INFRASTRUCTURE

The telecommunications infrastructure is defined as the cable and connecting hardware necessary to support the signaling between telecommunications devices. The infrastructure must be designed to support the known present, and reasonably certain future, signaling requirements of the telecommunications systems. With the rapid advances in telecommunications technology, the telecommunications infrastructure will likely require replacement or upgrade several times over the life of a building, with an average life expectancy of 10 to 20 years. Therefore, the design of the substructure has a major impact on the cost of future infrastructure upgrades. ANSI/TIA/EIA-568-B provides the standards to be applied to telecommunications infrastructure. See Telecommunications Substructure.

TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

A busbar placed in a convenient and accessible location in the Entrance Facility (EF), Equipment Room (ER), and all Telecommunications Closets (TC). All telecommunications equipment, equipment racks, protector blocks, metallic cable shields, and exposed noncurrent-carrying metal parts of information technology equipment are bonded to the TMGB, which is then bonded by means of the Telecommunications Bonding Backbone (TBB) to the main electrical service grounding electrode.

TELECOMMUNICATIONS SERVICE ENTRANCE FACILITY (EF)

The Telecommunications Service Entrance Facility is the point where the telecommunications service enters the customer's property. The EF may contain electronics equipment and line protection equipment required by the service provider. The EF may be combined with the Main Telecommunications Equipment Room, or the EF may be an outdoor pedestal or cabinet near the street. Other terms that are used in conjunction with the EF include:

1. Demarc – The point of demarcation between the service provider and the customer. This is actually a

cable termination block where the service provider's cable terminates, and is cross-connected to the customer's cable. It is usually located in the EF.

2. POP – Point-of-Presence. The physical location of the demarc.

3. MPOP – Minimum-Point-of-Presence. This is a policy statement, where it is generally the service provider's policy to locate the POP the minimum distance possible in from the street. The service provider usually prefers the POP to be at the street. However, the customer usually prefers the POP to be in the Equipment Room.

TELECOMMUNICATIONS SUBSTRUCTURE

The telecommunications substructure is defined as the equipment rooms, telecommunications closets, cable pathways, or other physical structures such as antenna towers, necessary to support telecommunications. Cable pathways include aerial pole lines, underground conduit systems, utility vaults, interior conduit systems, interior cable trays, or other methods of routing and supporting telecommunications cable. The telecommunications substructure shall be designed for the life of the building. ANSI/TIA/EIA-569-A provides the standards to be applied to telecommunications substructure. See Telecommunications Infrastructure.

TELECOMMUNICATIONS VAULT (UTILITY VAULT)

A large pre-cast concrete enclosure buried in the ground at a point not to exceed every 500-feet along an outside plant conduit run. Commonly referred to as a "maintenance hole." Telecommunications vaults are used as access points to facilitate pulling cable into major conduit duct banks, distributing cable from main conduit duct banks to branch conduits, and as the location for cable splices. "Manhole" is an obsolete term. See Handhole.

TERMINATION FIELD

A space on the plywood telecommunications backboard where termination hardware is mounted. The termination field is arranged into areas where different types of cables are terminated based on their purpose and use.

TERMINATION HARDWARE

Any device used on the end of a cable to connect or cross-connect cables to other cables, or to telecommunications equipment.

VOICE SERVICES

Voice services supported by the telecommunications infrastructure include telephone services, either directly from the Local Exchange Carrier (LEC), or from a DOC owned telephone system, voice mail services, intercom and paging services, and some radio systems. Fax services and individual computer modems usually operate over the voice system.

VOICE SWITCH

An electronic device that establishes or disestablishes circuits between telecommunications systems or devices.

WIDE AREA NETWORK (WAN)

A WAN is a network that interconnects various geographically separated sites that share common telecommunications requirements. A WAN usually supports a common organizational structure; e.g.., Department of Corrections, State of Washington, all law enforcement agencies. WANs can provide separate services for voice, data, and video, or combine all services into a common WAN.

WORK AREA

The work area is defined as the location where telecommunications service is provided for people to use. This is the area where a computer, telephone, or other telecommunications device is located and where people will use these tools to do work.

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Telecommunications Construction Guide Specification

Telecommunications Infrastructure Standards

Revision 5.0.1

Washington State Department of Corrections

May 2002

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TABLE OF CONTENTS

1 PREFACE

The Telecommunications Construction Guide Specification (TCGS) is written for designers of Washington State Department of Corrections (DOC) telecommunications distribution systems. It is intended to assist designers in developing project specifications that communicate DOC's requirements for the construction of telecommunications distribution systems at their facilities. The TCGS is written based on the Construction Specifications Institute (CSI) format, using Master Format, Section Format, and Page Format[1] structure. The TCGS reflects DOC and industry standards in effect as of this publication.

The TCGS was developed (in July 2001) from information contained in Revision 4 of DOC's Telecommunications Infrastructure Standards (TIS) in use at that time. It has been updated to reflect the methods, materials and industry standards that have evolved since TIS Revision 4 was published.

1.1 DOCUMENT INTENT

The Department of Corrections has developed the TCGS with the intent that DOC standards and practices are followed during the design and construction of telecommunications distribution systems.

Each TCGS specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State Department of Corrections telecommunications projects. This information is provided in specification format to serve as a guide to the Engineer/Designer in producing a CSI-compliant specification that will meet the unique requirements of DOC telecommunications projects.

However, the TCGS is intended to be a "Guide Specification" rather than a "Master Specification". The products listed and other information included in each section is not intended to be all-inclusive for any given project. Instead, each specification section is meant to serve as a starting point for developing the respective project specification section, with content to be added or removed as required.

In addition to having DOC standards and practices followed, the intent of the TCGS is to reduce the time required for DOC to review telecommunications project specifications. DOC hopes that consistently formatted and structured specifications will reduce the amount of time needed by DOC staff and RCDD Consultants to review the telecommunications specifications for each project.

Unless otherwise stated, the information in the TCGS applies to both new construction and remodel projects and (as appropriate) to leased facilities.

[1] For more information on CSI and the Master Format, contact the Construction Specifications Institute at: 601 Madison Street, Alexandria, VA 22314. Phone: (800) 689-2900 Email: csimail@csinet.org; Internet: www.csinet.org

1.2 HOW TO USE THIS DOCUMENT

The TCGS contains 5 specification sections:

- 16108 – Outside Plant Communications Site Work
- 16131 – Raceway and Boxes for Communications Circuits
- 16453 – Bonding and Grounding for Telecommunications
- 16740 – Inside Plant Communications Circuits
- 16741 – Outside Plant Communications Circuits

The TCGS is to be used in conjunction with the Telecommunications Distribution Design Guide (TDDG) to produce Contact Documents for bidding or to assist DOC selected personnel in the design and administration of small telecommunications construction projects.

DOC has standardized on the format and content of the specification sections that are included in the TCGS. For this reason, the Engineer/Designer shall edit each electronic specification section provided by DOC directly in Microsoft Word 2000 (or later), adding and/or removing content where required to meet the unique needs of a given project. The Engineer/Designer shall not create a new specification section based on the "intent" of the TCGS or cut and paste content from TCGS sections into other existing specification sections.

To this end, and in order to assist DOC staff with the specification review process, all edits to the original TCGS electronic documents provided to the Engineer/Designer by DOC shall be made using Microsoft Word with "Revision Marks" turned on. The specification sections shall be submitted in hardcopy format when required by DOC during the design review process with the "Show Revision Marks in Printed Document" option selected.

Text in shaded boxes in each TCGS section is formatted in Microsoft Word as "hidden text" and can be made to not appear on screen and/or not appear in the printed document by selecting the appropriate check boxes in the options menu. The hidden text is included to aid the Engineer/Designer in understanding areas of the Guide Specification that may require modification for a particular project. Although this text is generally written in declarative form, the Engineer/Designer shall consider it guidance only. ***The Engineer/Designer shall not assume that the content of each specification section is suitable or sufficient for any given project in its current form and shall remain responsible for adding and/or removing content as required to develop a thorough and complete specification section that meets the requirements of the project being designed.***

SECTION 16108 – OUTSIDE PLANT COMMUNICATIONS SITE WORK

SECTION 16108 — OUTSIDE PLANT COMMUNICATIONS SITE WORK

PART 1 — GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State Department of Corrections telecommunications projects. This information is provided in specification format to serve as a guide to the Engineer/Designer in producing a CSI-compliant specification that will meet the unique requirements of DOC Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Engineer/Designer may edit this section (adding and/or removing content where required) for use with a particular project, but shall not create a new specification section based on the "intent" of the TCSG, or cut and paste content from TCSG sections into other existing specification sections.

Text in shaded boxes (such as this text) is included to aid the Engineer/Designer in understanding areas of this Guide Specification that may require modification for a particular project. Although this text is generally written in declarative form, the Engineer/Designer shall consider it guidance only. The Engineer/Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

1.1 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this Section.

1.2 SUMMARY

Review and edit the following list of generic type products and work for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

A. Provide all materials and labor for the installation of a pathway system for outside plant communications circuits. Work in this section includes excavation and trenching, conduit (raceway) construction, cutting and patching, concrete, maintenance hole and handhole construction, and landscaping.

B. Related Sections

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the contractor's responsibility for coordinating work.

1. Division 16 Section — "Basic Electrical Materials and Methods"
2. Division 16 Section — "Raceway and Boxes for Communications Circuits"
3. Division 16 Section — "Grounding and Bonding for Telecommunications"

C. Products furnished (but not installed) under this section:

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. DOC frequently has the Contractor furnish patch cords, but uses their IT staff to install. When installations are "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner- Installed Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

D. Products installed (but not furnished) under this section -

Include this paragraph only if products will be installed under this section but furnished under other sections or by the Owner. For example, DOC may pre-purchase fiber, but have the Contractor install. When products are furnished "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner-Furnished Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

Consider including paint for backboards, grounding conductors, and any other items that are installed under this section but not furnished under this section.

1. Grounding Conductor

E. Provide Unit Prices for:

Include this paragraph only if unit pricing will be required for a specific part of the project. Include statements on how to measure the quantity. For example, unit prices may be requested for trenching, conduit, etc. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Engineer/Designer shall verify with the DOC Project Manager and/or the DOC IT Specialist assigned to the project whether the latest edition and/or addenda of each required reference is appropriate and specify the edition and addenda below accordingly.

A. Incorporate by reference the applicable portions of the following specifications, standards, codes into this specification section.

1. General:

a. National Electrical Code (NEC)

b. National Electrical Safety Code (NESC)

c. Washington Industrial Safety and Health Act (WISHA)

d. Occupational Safety and Health Act (OSHA)

e. WSDOT/APWA 1998 Standards Specifications for Road, Bridge and Municipal Construction (APWA Standard Specifications)

2. Communications:

a. ANSI/TIA/EIA - 758 : *Customer-owned Outside Plant Telecommunications Cabling Standard*

b. ANSI/TIA/EIA - 568: *Commercial Building Telecommunications Cabling Standard*

c. ANSI/TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*

d. ANSI/TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*

e. ANSI/TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*

f. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*

g. BICSI: *BICSI Telecommunications Cabling Installation Manual (CIM)*

h. BICSI: *BICSI Telecommunications Distribution Methods Manual (TDMM)*

i. BICSI: *BICSI Customer-Owned Outside Plant Design Manual (CO-OSP)*

3. Concrete:

a. Reinforcement:

1) ACI 301: Structural Concrete for Buildings

2) ACI SP-66: American Concrete Institute - Detailing Manual

3) ANSI/ASTM A82: Cold Drawn Steel Wire for Concrete Reinforcement

4) ANSI/AWS D1.4: Structural Welding Code for Reinforcing Steel

5) ANSI/AWS D12.1: Reinforcing Steel Welding Code

6) ASTM A615: Deformed and Plain Billet Steel Bars for Concrete Reinforcement

7) AWS D12: Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete Construction

b. Cast-in-Place:

1) ACI 212.3R: Chemical Admixtures for Concrete

2) ACI 301: Structural Concrete for Buildings

3) ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete

4) ACI 305R: Hot Weather Concreting

5) ACI 306R: Cold Weather Concreting

6) ASTM C33: Concrete Aggregates

7) ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

8) ASTM C94: Ready-Mixed Concrete

9) ASTM C150: Portland Cement

10) ASTM C143: Standard Test Method for Slump of Hydraulic Cement Concrete

11) ASTM C173: Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

12) ASTM C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

13) ASTM C260: Air Entraining Admixtures for Concrete

14) ASTM C309: Standard Specifications for Liquid Membrane Forming Compound for Curing Concrete

15) ASTM C494: Chemical Admixtures for Concrete

c. Pre-Cast:

1) ASTM C478: Standard Specification for Precast Reinforced Concrete Manholes Sections

2) ASTM C857: Standard Practice for Minimum Structural Design Loading for Underground Precast Utility Structures

3) ASTM C858: Standard Specification for Underground Precast Concrete Utility Structures

4) ASTM C891: Standard Practice for Installation of Underground Precast Concrete Utility Structures

5) ASTM C1037: Standard Practice for Inspection of Underground Precast Concrete Utility Structures

6) ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

4. Trenching and Backfill:

a. ASTM D1557: Test Method for Laboratory Compaction Characteristics Using Modified Effort

1.4 DEFINITIONS

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Engineer/Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - “Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations”.

Install - “Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations”.

Provide - “To furnish and install, complete and ready for the intended operation”.

A. Aggregate: Mineral materials such as sand or stone used in making concrete

B. Backfill: Earth material used specifically for filling and grading excavations back to a finished state. Backfill is placed on top of the bedding surrounding encased ductbanks and direct-buried conduits.

C. Base: Earth material used specifically to level and grade an excavation’s subgrade for the subsequent placement of encased ductbanks, direct-buried conduit, maintenance holes and handholes. Base material is placed on top of the subgrade and beneath the bedding surrounding encased ductbanks, conduits, maintenance holes or handholes.

D. Bedding: Earth material used specifically for filling excavations. Bedding is placed around encased ductbank, conduits, maintenance holes or handholes. Bedding is placed on top of the base and beneath the backfill.

E. Fill: The collective term for base, bedding, and backfill.

F. Handhole (HH): A structure similar to a small maintenance hole through which cable can be pulled, but not large enough for a person to fully enter to perform work.

G. Maintenance Hole (MH): A vault located in the ground or earth as part of an underground conduit system and used to facilitate placing, connectorization, and maintenance of cables as well as the placing of associated equipment, in which it is expected that a person will enter to perform work.

H. RNC: Rigid Non-Metallic Conduit (PVC)

I. PSC: PVC Coated Rigid Steel Conduit.

J. RGC: Rigid Galvanized Steel Conduit

1.5 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete Outside Plant pathway system as hereinafter specified and/or shown on the Contract Documents. The Pathway system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in 16741 (or equivalent) - “Outside Plant Communications Circuits”.

B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant pathway system.

1.6 SUBMITTAL INFORMATION

Review and edit the following list of submittals as applicable to this project. Note that the submittals listed below are specific to this section only. Division 1, Section 01300 (or equivalent) – Submittals should include general administrative requirements (e.g. schedule, number of copies, distribution, etc.). Either Section 01300 or this section should include a statement similar to the following, “The Contractor shall apply Contractor’s stamp, sign, or initial certifying that review, verification of required Products, and coordination of information is in accordance with the requirements of the work and Contract Documents.

Any deviations from the Contract Documents or specified product data shall be clearly noted, and must be approved by the Engineer/Designer prior to start of construction. The Engineer/Designer shall obtain approval from DOC through the Alternative Design Request (ADR) process prior to approving a Contractor-submitted deviation.

If the deviation is not approved by the Engineer/Designer it remains the Contractor's responsibility to provide what is required in the Contract Documents".

A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.

1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.

2. For those items noted as allowing "or equal," and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.

3. Provide standard manufacturer's cut sheets and the operating and maintenance (O&M) instructions at the time of submittal review for each device in the system, regardless of whether it is submitted as specified or as an approved equal. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive the materials.

B. Quality Assurance/Control Submittals: Provide submittal information for review as follows:

1. Submit a copy of the delivery receipt for each concrete delivery. Include date, strength ordered, and location used.

C. Closeout Submittals: Provide submittal information for review as follows:

A telecommunications-specific Operations and Maintenance (O&M) Manual for Communications shall be required for each project. O&M information submitted under other related communications sections (e.g. Raceway and Boxes for Communications Circuits, Bonding and Grounding for Communications, etc.) shall be included in the O&M Manual and statements should be included in each section directing the Contractor to provide applicable information in the O&M Manual for Communications. The requirement that the Contractor provide an O&M Manual for Communications should be stated in the Outside Plant Communications Circuits section or in Inside Plant Communications Circuits.

1. O&M Manual for Communications - At the completion of the project, submit O&M information from product data submittals (above), updated to reflect any changes during the course of construction, to the Engineer/Designer in the telecommunications-specific O&M Manual for Communications binder labeled with the project name and description.

2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.

b. Keep Record Drawings at the job site and make available to the Owner and Engineer/Designer at any time.

c. Keep Record Drawings current throughout the course of construction. (“Current” is defined as not more than one week behind actual construction).

d. Show identifiers for major infrastructure components on Record Drawings.

1.7 SEQUENCING

State any requirements for coordinating work with potentially unusual or specifically required sequencing. DOC may choose to construct a project under two bid packages - one for OSP Site Work as described in this specification section as well as other General Contractor specific work, and a second bid package for the Structured Cabling System. The Engineer/Designer must coordinate with DOC to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing, schedules and the use of DOC provided security escorts.

1.8 CONTRACTOR WARRANTY:

Coordinate this paragraph with the conditions of the contract and Division 1 requirements to ensure that no statements are made that will limit or void those conditions. A thorough understanding of the warranties applicable on this project is required. The Engineer/Designer shall consider and account for unique warranty situations that may arise from owner furnished equipment, owner installed equipment, or other situations that may conflict with warranty requirements.

A. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.

1. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.

a. The Contractor Warranty period shall commence upon Owner acceptance of the work.

2 PART 2 — PRODUCTS

PART 2 — PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

The following paragraphs include products that do not indicate that they allow “or equal” substitutions. If the Engineer/Designer wishes to use other products, an alternative product request shall be submitted in writing to the DOC IT Infrastructure Specialist. This request shall follow the format and procedures of the Alternative Design Request identified in the TDDG, and include detailed literature from the manufacturer of the alternative product. If the alternative product is approved, the Engineer/Designer shall ensure that the specification is written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 - Products below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by their design are specified with equal or greater detail to the following paragraphs. The Engineer/Designer shall also verify that the most current part number of each specified product is listed in this section.

2.1 GENERAL

A. Materials shall consist of fill, topsoil, concrete formwork, concrete, raceway, maintenance holes, handholes and other incidentals and accessories as required.

2.2 BASE, BEDDING AND BACKFILL

Review and edit the following products/part numbers as applicable to this project.

A. Use of on-site soils for base, bedding, and backfill is not acceptable.

B. Base: Readily compactible and meet the following gradation requirements.

1. For Maintenance Holes and Handholes (provide gravel):

Sieve Size	Percent Passing
1" Square	100
¼" Square	25 - 80
U.S. No. 200	15 max
Sand Equivalent	30 min

2. For Trenches (provide sand):

Sieve Size	Percent Passing
U.S. No. 10	35 - 100
U.S. No. 20	20 - 80
U.S. No. 40	10 - 55
U.S. No. 100	0 - 10
U.S. No. 200	0 - 3

C. Bedding: Same as Base - For Trenches, above.

D. Backfill:

1. For Maintenance Holes and Handholes - Same as Base - For Maintenance Holes and Handholes, above.

2. For Trenches

Sieve Size	Percent Passing
½" Square	100
¼" Square	65 - 100
U.S. No. 10	40 - 100
U.S. No. 50	3 - 50
U.S. No. 100	0 - 4

U.S. No. 200 0 - 3

2.3 CAST-IN-PLACE CONCRETE

Review and edit the following products/part numbers as applicable to this project.

A. Formwork:

1. Forms: Metal or plywood in good condition

   a. Form Release Agent: Burke Form Coating (or equal)

2. Gypsum board

B. Reinforcement:

1. Reinforcing Steel: ASTM A615, Grade 40. Uncoated, free from rust, dirt, and loose scale.

2. Tie Wire: 18 gauge 40 or heavier black annealed wire.

3. Embedded Anchor Bolts: Mild galvanized steel, cold bent.

C. Concrete:

1. Cement: Different types of cement, including the same type of cement provided by more than one manufacturer, are not acceptable: Cement shall conform to:

   a. ASTM C150-7, type 1.

   b. 2500 psi. minimum compressive at 28 days per ASTM C39.

   c. 4 inches maximum slump per ASTM C-143.

2. Aggregate:

   a. Course: ASTM C33-71 with a maximum size of 1-¼".

   b. Fine: ASTM C33-71.

3. Water: Fresh, clean, potable and not detrimental to concrete.

4. Admixtures:

   a. Air Entrainment: Conform to ASTM C260 and ASTM C173 or C231 with 5% to 7% air entrainment.

   b. Other: Not allowed without prior approval from the Engineer/Designer.

5. Curing Compound: Conform to ASTM C309. Free from petroleum resins or waxes. Formulated for sealing, surface hardening, and curing concrete.

List additional products above as applicable to this project.

2.4 CONDUIT AND DUCTBANKS

Review and edit the following products/part as applicable to this project.

A. Conduit

1. Rigid Non-Metallic Conduit (RNC):

   a. UL listed, NEMA TC2 and TC6 Schedule 40 or 80 rigid polyvinyl chloride (PVC) approved for direct burial without concrete encasement

   b. Fittings: NEMA TC3 and TC9, matched to conduit and material.

2. Rigid Galvanized Steel Conduit (RGC):

   a. Rigid steel conduit hot-dipped galvanized inside and out with threaded ends meeting ANSI C80.1.

   b. Couplings: Unsplit, NPT threaded with galvanizing equal to (and compatible with) conduit. Running thread or set screw threaded fittings (except for three piece and watertight split couplings) are not acceptable.

   c. Nipples: Same as conduit, factory-made up to 8 inches in diameter, no running threads.

3. PVC Coated Rigid Steel Conduit (PSC):

   a. NEMA RN 1 rigid steel conduit coated with rigid polyvinyl chloride (PVC).

   b. Fittings: NEMA RN 1.

4. Fittings:

   a. Sweeps: Factory manufactured with a single arc of not less than a 15 foot radius.

   b. End Caps (Plugs): Pre-manufactured and water-tight. Tape is not an acceptable end cap or cover.

5. Pull Ropes: ¼ inch polypropylene with a minimum tensile strength of 200 pounds.

B. Ductbanks:

1. Conduit Spacers/Supports: High-density plastic interlocking spacers/supports. Spacers shall be:

   a. Underground Devices Inc.: WUNPEECE

2. Warning Tape: 6” wide metallic warning tape, orange in color.

3. Grounding/Bonding: #2 bare copper ground

List additional products to the above information as applicable to this project.

2.5 UNDERGROUND SPACES

Review and edit the following products/part numbers as applicable to this project.

A. General: Underground spaces include Maintenance Holes (MH) and Handholes (HH). Incidental and miscellaneous equipment supplied with a MH or HH shall be supplied by the same manufacturer.

B. Maintenance Holes: Precast, conform to ASTM C478 and other ASTM standards and specifications as listed in REFERENCES above. Complete with concrete floors, lockable covers, permanently installed ladders, pulling eyes, and 12” diameter closed sumps.

1. Sizes and Types:

The Engineer/Designer shall include MH sizes as required for the project. The size described below is an example to indicate specification language and detail.

a. Utility Vault Company: 4484-TA 5'-0" W x 9'-0" L x 7'-2" H (exterior dimensions). Complete with Alternate Top Section 4484-T42C, Center Section 4484-MT, Base Section 4484-BT, and section gaskets. Equipped with (3) galvanized "C" imbedded channels per longitudinal side and knockouts for conduit entry (Term-a-duct shall not be used).

1) Cover and Frame: Utility Vault Company CASTING 30" x 10"

2. Racking and Hardware: Galvanized.

3. Risers:

a. 4 inch high: Utility Vault Company No. 4204

b. 6 inch high: Utility Vault Company No. 4206

c. 12 inch high: Utility Vault Company No. 4212

C. Handholes: Complete with 8" diameter closed sumps, diamond plate cover, section gaskets, and one (1) galvanized pulling iron per longitudinal side (two (2) total).

1. Sizes and Types:

a. Shope Concrete Products Company: J-11A Standard Plan Type-3; 2'-6" W x 3'-6" L x 4'-0" H

2. Covers and Frames:

a. For J-11A: Conform to AASHTO H10 loading with the same nominal length and width as the handhole. Complete with self-latching stainless steel slam locks, recessed lift inserts, lock down bolts.

3. Racking and Hardware:

a. For J-11A: Provide as shown on the Drawings.

D. Grounding:

1. ¾" x 10' copperclad steel ground rods

2. #4/0 pigtail for connection to interior ground conductors.

List additional products to the above information as applicable to this project.

2.6 FIRESTOPPING MATERIAL:

A. Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test in a configuration that is representative of the actual field conditions. Manufactured by:

1. Specified Tech. Inc.

Review and edit the following products/part numbers as applicable to this project.

2.7 LABELS:

A. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, typed, and created by a hand-carried label maker or an approved equivalent software-based label making system. Handwritten labels are not acceptable.

1. Hand-carried label maker:

a. Brady: ID Pro Plus (or approved equal).

2. Labels:

a. Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

2.8 LANDSCAPING:

Review and edit the following products/part as applicable to this project.

A. Topsoil: Imported from off construction site.

3 PART 3 — EXECUTION

PART 3 — EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If it is desirable to use other products, the Engineer/Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by their design are specified in Part 2 with corresponding installation requirements specified in Part 3.

3.1 GENERAL

A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.

B. All work shall comply with applicable safety rules and regulations including OSHA and WISHA. All work shall comply with the requirements of the National Electrical Safety Code (NESC) and the NEC except where local codes and/or regulations are more stringent, in which case the local codes and/or regulations shall govern.

C. All work shall comply with the standards, references and codes listed in PART 1 -- REFERENCES above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.

D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.

E. Replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.

F. Remove surplus material and debris from the job site and dispose of legally.

3.2 EXCAVATING, TRENCHING AND FILL

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Excavation:

1. Do not excavate when the outside temperature is less than 35° F or when there is standing water or snow on the subgrade.

2. Where crossing of concrete or asphalt is required, saw cut and remove surface material prior to excavating. Remove concrete in complete sections from control joint to control joint regardless of the width of the excavation. Restore concrete and asphalt surfaces following excavation to match existing depth, strength, color, and type of material.

3. If an adjacent structure may be compromised or damaged by excavation work, underpin the structure as required. If the structural integrity is in question, obtain an evaluation and recommendation from a registered structural Engineer/Designer employed by the Contractor prior to proceeding with the work.

4. Maintain adequate separation between the excavation and adjacent underground utilities. Locate excavations such that ductbanks, maintenance holes, and handholes have a minimum separation of twelve (12) inches between the ductbank and/or MH/HH and the nearest underground utility after installation. For gas lines a minimum separation of eighteen (18) inches is required. For water a minimum separation of thirty-six (36) inches is required. Contact the Engineer/Designer prior to proceeding if minimum separation distances can not be achieved.

5. Protect excavations at the end of the work shift. Cover with steel sheets and barricade prior to leaving the job site, in accordance with all applicable rules, regulations, building codes, and ordinances.

6. Install, operate and maintain pump or dewatering equipment as necessary to prevent water from accumulating in the excavation.

7. Excavation Depth/Width

   a. For MH/HH: Excavate to a sufficient depth to cover the overall assembled height of the vault plus the added height of risers, covers and bedding material consisting of a minimum six (6) to twelve (12) inches of base. Excavate to a sufficient width to provide a minimum of six (6) inches clearance around each side of the MH/HH.

   b. For trenches: Excavate to a sufficient depth to provide a minimum of thirty (30) inches cover over the conduit or ductbank formation and to allow for the proper alignment of conduits into the MH/HH. Excavate to a sufficient width to provide a minimum of six (6) inches to each side of the ductbank formation.

8. Over-excavate, fill, and compact any soft spots in the subgrade.

9. Run trench excavation true and as straight as possible. Clear trenches of stones and soft spots.

10. Slope trench grade to fall 3 inches per 100 feet in general and ¼” per foot where possible.

    a. Slope trench toward lower MH/HH or from high points toward MH/HH at both ends.

    b. Slope trench away from building entrances.

B. Fill:

1. Drain and/or pump groundwater and surface water from the recipient area prior to the placement of fill.

2. Do not place frozen fill.

3. Base:

   a. Scarify and moisture condition the subgrade bed to receive fill prior to placing materials.

   b. Moisture condition base material to within three (3) percent of optimum moisture content and place in loose, horizontal layers.

   c. Level the subgrade bed using sand for trenches and gravel for MH/HH as necessary to form an even base.

4. Bedding:

   a. For concrete encased ductbank:

      1) Do not exceed 4" depth of bedding lifts/layers before compacting.

   b. For Direct-buried Ductbank:

      1) Provide a minimum of 3" hard tamped sand around conduit. Do not exceed 1" to 2" depth of bedding lifts/layers before compacting until the top of the ductbank is reached and do not exceed 4" thereafter. Place bedding simultaneously on both sides of ductbank for the full width of the trench. Carefully work the materials above, to each side, and below the conduits with a tool capable of preventing the formation of void spaces and without damaging the structure or waterproofing of the conduits.

5. Backfill:

   a. Do not exceed 6" depth of backfill lifts/layers before compacting.

6. Compaction: Compact using a vibratory plate or roller or other mechanical device. Compaction through jetting and/or pounding is not acceptable. Compact per APWA Standard Specification Paragraph 7-10.3 (11).

   a. Bedding: Compact material to a dense state equaling at least 95% of the maximum dry density per ASTM D1557.

   b. Backfill: Compact material up to two (2) feet below the finished grade with a minimum relative compaction of 90% of the maximum dry density per ASTM D1557. Compact material from two (2) feet below the finished grade up to the finished grade with a minimum relative compaction of 95% of the maximum dry density per ASTM D1557.

The Engineer/Designer shall coordinate with local DOC authorities to determine whether DOC wishes to have the fill material from the trenching deposited elsewhere on the site or hauled away. Review and edit the following waste disposal requirements to accommodate DOC's fill material removal wishes as applicable to this project.

C. Waste Disposal: Remove excavation materials and other construction debris from the site in a timely manner and dispose of legally.

3.3 CAST-IN-PLACE CONCRETE

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Construct concrete in accordance with the applicable portions of the specifications, standards, codes and regulations (latest editions and/or amendments) listed in Section 1, References.

B. Formwork:

1. Construction:

a. Forms: Use the most advantageous panel sizes and panel joint locations. Neat patches and minor surface imperfections will be permitted. Form surfaces in true planes within ¼ inch in 10 feet. Clean forms and remove debris prior to pouring concrete. Make braces unyielding and tight to prevent leakage. Maintain formwork construction tolerances complying with ACI 347. Formwork shall be readily removable without impact, shock, or damage to concrete surfaces and adjacent materials. Use chamfer strips fabricated to produce uniform smooth lines and tight edge joints for exposed corners and edges. Note: chamfer strips are not required for concrete encased ductbank corners and edges.

1) Gypsum board shall not be used for forms except to form concrete encased ductbank.

b. Reinforcement: Construct reinforcement in accordance with ACI SP-6. Weld reinforcement in accordance with ANSI/AWS D1.4 or ANSI/AWS D12.1. Accurately position, support, and secure reinforcement against displacement. Support reinforcement by metal/plastic chairs, runners, bolsters, spacers, hangers, or other incidental materials as required.

c. Where metal or plywood forms are used, coat the forms with a form release agent prior to placement of concrete. Coat faces and edges of forms applied at a rate of 500 to 550 square feet per unit.

d. Curved Surfaces: Use only curved forms for constructing curved structures and surfaces.

2. Slope: For flatwork, construct forms with 1% side slope to both south and east sides.

3. Joints:

a. Control: Build into form.

b. Expansion: Build expansion joints into form, premolded ½” thick, and conforming to ASTM D1751. Seal the top ½” of expansion joints with an approved joint sealer.

4. Removal: Remove forms after concrete has cured (see Curing below) for 7 days or after concrete has attained a compressive strength of 2000 psi.

a. Where gypsum board forms are used to form concrete encased ductbank they can be left in place and backfilled after the specified curing period.

C. Concrete:

1. Transport: Comply with ACI 304. Transport concrete from the mixer to the construction location via methods preventing separation of materials.

2. Application:

a. Prior to placement, inspect and complete formwork construction, reinforcement, and items to be embedded or cast-in.

b. Deposit concrete in forms in layers not deeper than 24” and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer on the preceding layer while the preceding layer is still plastic. Cold joints are not acceptable.

c. Deposit concrete in a plastic condition and uniformly work around reinforcements.

d. Consolidate concrete using internal machine vibration (stinger) during pouring.

e. Once concrete work has commenced, work continuously until the work segment and/or section has been completed.

f. Cold Weather: Protect concrete from damage caused by frost, freezing, or low temperatures in compliance with ACI 306R. When temperature is below 40° F, heat water and aggregates before mixing to obtain a concrete mixture of not less than 50° F and not more than 80° F.

g. Hot Weather: Protect concrete from damage caused by hot weather in compliance with ACI 305R. When temperature is above 90° F chill water before mixing to obtain a concrete mixture of not more than 90° F. Cover reinforcing steel with water-soaked burlap if it becomes too hot immediately before placement of concrete. Temperature of steel shall not exceed the ambient air temperature.

3. Curing:

a. Curing method and rate of application shall be according to manufacturers recommendations.

b. Protect concrete from premature drying, rain, excessive temperatures, and mechanical injury during the curing period.

c. Cure concrete for 7 days in accordance with ACI 301 and keep continuously moist during this time. Maintain concrete temperature between 50° and 90° F during the curing period.

d. Provide curing and sealing compound to exposed slabs, sidewalks, curbs, etc. as soon as final finishing operations are complete (within 2 hours). Re-coat areas subjected to heavy rainfall within 3 hours of the initial application.

4. Finish:

a. Consolidate, level and screen surfaces for evenness and uniformity. Remove excess concrete. Fill low spots. Float the surface after water sheen has disappeared from surface.

b. Finish flatwork with a special tool to match patterned finish of adjacent existing concrete.

c. Tool edges, control, and expansion joints to make finish work straight and even.

5. Ductbanks:

a. Reinforce ductbanks along full length with formed sides. Install reinforcement at each corner of the conduit spacers/supports.

b. Do not pour concrete against trench walls. Consolidate concrete during placement using an internal concrete vibrator.

c. Provide each MH/HH penetration with reinforcing bars tied to MH/HH reinforcement. Dowel reinforcement in foundation wall of building penetrations.

d. Secure conduit spacers/supports and reinforcing to prevent movement during concrete placement. Use stakes and/or tie wire to minimize floating and spreading.

6. Protection for exposed concrete: Cover exposed concrete (i.e. sidewalk, driveway, etc.) with plywood, weighted with concrete blocks or similar heavy object in order to prevent surface damage.

7. Bond and ground reinforcement bars to the nearest approved ground.

3.4 CONDUITS AND DUCTBANKS

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Conduits:

1. Outdoor underground: Provide either

   a. RNC Schedule 40 (Type 1).

   b. RGC with half lapped wrap of Scotchrap No. 51 plastic tape or a coat of Kopper's Bitumastic No. 505 (minimum 20 mil thickness).

2. Outdoor exposed: Provide RGC.

3. Transitions: Transition to PSC at stub up locations. Transition to PSC for building entrances a minimum of 10 feet before reaching building foundation. Transitioning back to RNC after passing 5 feet inside the building foundation is acceptable.

4. Sweeps:

   a. Shallow curves comprised of continuous lengths of individual straight RNC conduit are permissible with a minimum sweep radius of 40 feet. Where the radius is less than 80 feet, the conduit must be encased in concrete with a minimum of 2 inch cover on top, bottom and sides.

   b. Where the conduit sweep radius is less than 40 feet, sweeps shall be factory-manufactured bends with a minimum of 15 foot radius. Bending conduit in the field using manual or mechanical methods is not acceptable.

      1) Where existing conditions do not permit the installation of a 15-foot radius sweep, a factory-manufactured 4-foot sweep may be used, with advance approval of the Engineer/Designer on a case-by-case basis. The sweep shall be either:

         a) PSC

         b) Concrete-encased RNC

   c. Do not exceed 90 degrees for an individual sweep.

   d. A conduit section shall have not more than the equivalent of two 90-degree sweeps (a total of 180 degrees) between pull points. The 180-degree maximum shall include kicks and offsets. Where it is not possible to construct a section of conduit within the 180-degree sweep maximum, an intermediate MH/HH shall be installed.

   e. Two 90-degree sweeps separated by less than 10 feet is not permissible.

   f. Construct sweeps for conduits within a common ductbank parallel, measured from the same center-point.

   g. Do not install LB's, condulets, or 90 degree electrical elbow.

5. Fittings:

a. Cut conduit ends square and ream to remove burrs and sharp ends. Extend conduits the maximum distance into fittings, couplings, and/or connectors. Tighten fittings securely and seal watertight (see below).

b. End Caps (Plugs): Provide end caps on conduit ends throughout construction to prevent the intrusion of water or debris. Install end caps on conduit that is not directly being worked on during the work day and on conduits at night. Leave end caps in place upon final completion of the work.

c. End Bells: Provide end bells for terminating conduit in maintenance holes and handholes. Install protective end bells on conduits flush with MH/HH walls. Do not use TERM-A-DUCT.

6. Sealing: Apply a watertight, conductive thread compound (for PSC) or solvent-type cement (for RNC) to make conduit connections waterproof and rustproof. Seal and grout conduit terminations in maintenance holes and handholes to ensure that voids in the joints are filled. Seal conduit terminations in buildings until used for cable.

7. Cleaning: After installation, and within five days prior to releasing conduit for cabling installation, clean each conduit with a wire brush and swab. Clean each conduit a minimum of two times in the same direction and swab with clean rags until the rag comes out of the conduit clean and dry. Swab away from buildings for conduit sections connected to buildings.

8. Test Mandrels: Prove out each conduit with a minimum 16 inch long test mandrel that is ¼ inch smaller than the inside diameter of the conduit. Pull the test mandrel after backfilling but prior to the replacement of landscaping. Repair or replace any conduit that does not prove out at no cost to the Owner.

9. Conduit Entrances:

a. MH/HH: Conduit entrances at opposite ends of a maintenance hole or handhole shall be at the same level and in the same position with respect to the side walls. Ensure that each conduit leaving a MH/HH in any position enters the next MH/HH in the same relative position.

b. Buildings: Terminate conduits 4-inches above the finished floor.

10. Length: Unless otherwise shown on the Drawings, do not exceed 600 feet of ductbank between pulling points. Contact the Engineer/Designer prior to proceeding if a ductbank section will exceed 600 feet.

11. Pull Ropes: Install in each conduit immediately after the conduit has been cleaned and mandreled. Leave a minimum of 10 feet looped and tied off at each end of the conduit.

12. Protection: Insure that after installation the conduit coatings and finishes are without damage. Repair as follows:

a. PVC Coated Rigid Steel Conduit: Patch nicks and scrapes in PVC coating after installing conduits.

b. Rigid Non-metallic Conduit: Repair damage with matching touchup coating recommended by the manufacturer.

B. Ductbanks:

1. Unless otherwise noted on the Contract Documents or required for sweep radius, construct ductbanks without concrete encasement. Where shown as concrete encased, use concrete encased RNC (see CAST-IN-PLACE CONCRETE, above).

2. Encased in Concrete:

   a. See CAST-IN-PLACE CONCRETE, above.

3. Conduit Spacers/Supports: Place supports on eight (8) foot centers if encased in concrete and five (5) foot centers otherwise. Interlock spacers horizontally only. Stagger spacers encased in concrete at least six (6) inches vertically.

4. Warning Tape: Install metallic warning tape half the distance between the top of the ductbank and finished grade.

5. Grounding/Bonding: Install ground wire along length of ductbank. Bond to grounding electrodes of MH/HH and to building service grounds.

6. Slope ductbank grade to fall 3 inches per 100 feet in general and ¼" per foot where possible.

   a. Slope ductbank toward lower MH/HH or from high points toward MH/HH at both ends.

   b. Slope ductbank away from building entrances.

3.5 UNDERGROUND SPACES

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Precast maintenance holes and handholes shall be free from damaged joint surfaces, cracks, or other damage that would permit infiltration. Repair of defects is not acceptable. MH/HH and incidental and miscellaneous equipment (such as cable racking brackets and supports) shall be supplied by a single manufacturer.

B. Install MH/HH according to manufacturer's instructions.

C. MH: Use 30" wide x 10" high circular frames/covers and provide with minimum 4" and maximum 12" high circular maintenance hole entrance riser sections as required. Use the riser sections to maintain the top of the maintenance hole cover 1" above the existing ground line or finished grade. Taper pavement surfaces up to the top of the maintenance cover. Provide covers embossed in the lid casting with minimum 2" high letters stating "COMMUNICATIONS", and conform to AASHTO H20 loading. Provide lock-down bolts. Cover frames shall be cast ductile iron, conforming to the same AASHTO requirements as the covers. Covers and frames shall be of uniform quality, free from blowholes, porosity, shrinkage, distortion, cracks and other defects. Repair of defects is not acceptable. Mating surfaces between covers and frames shall be machine finished to ensure a non-rocking fit.

D. HH: Provide covers embossed in the lid casting with minimum 2" high letters stating "COMMUNICATIONS". Maintain the top of the handhole hole cover 1" above the existing ground line or finished grade. Taper pavement surfaces up to the top of the handhole cover.

E. Setting and Placement: Remove water from excavation and properly install bedding material prior to setting the MH/HH. Clean MH/HH section seal surfaces so that they are free from dirt or other material.

   1. Set MH/HH in place by lowering each section into the excavation, ensuring that the section is level, plumb, and firmly positioned, and ensuring that the section gasket/seal is properly installed and watertight prior to setting the next section.

   2. Carefully set the MH/HH to ensure that the rim or lid elevation is set one inch above finished grade. For vaults located in paved areas, taper pavement up to the MH/HH rim.

F. Knockouts: Remove knockouts striking the knockout with a single moderately heavy blow with a hammer or similar tool.

G. Grouting: Apply grout in a manner to insure filling of voids in the joints being sealed. Apply grouting to conduit entrances, risers, and covers in addition to any other voids.

H. Racking and Hardware: Install racking and hardware and incidental materials. Provide three (3) cable racks per longitudinal side (six (6) racks total) per maintenance hole. Provide eight (8) 7-½" cable support arms per manhole. Provide additional incidental hardware for mounting racks and cable support arms.

I. Risers: Provide riser sections that are a minimum of 4" high and a maximum 12" high, sized for the MH entrance. Provide riser sections in quantities sufficient to meet the minimum and maximum height requirements discussed above.

J. Grounding/Bonding: Provide a minimum of one ¾" x 10' copperclad steel ground rods, and one #4/0 pigtail for connection to interior ground conductors. Bond metallic hardware in the vault to the pre-cast bonding tabs. Bond the bonding tabs to the ground rod.

K. Cleaning: Clean and dry the MH/HH after construction activity is complete and prior to releasing the MH/HH to the Owner for the Owner's use.

3.6 LANDSCAPING

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Topsoil: Provide imported topsoil for excavations in grass and/or landscaped areas. Provide loosely compacted topsoil to a depth of 4" or depth of excavation for excavations less than 12". Restore existing grades where disturbed. Rake and smooth topsoil following proper placement. Installation shall be approved by the Owner prior to placing sod. Place topsoil per APWA Paragraph 8-01.3(2).

B. Provide sod for grass areas disturbed by construction activity and replace shrubbery and trees damaged, removed or disturbed by construction activity. The use of seed/hydroseed shall be approved by the Owner and the Engineer/Designer prior to installation.

END OF SECTION

SECTION 16131 – RACEWAY AND BOXES FOR COMMUNICATIONS CIRCUITS

SECTION 16131 — RACEWAY AND BOXES FOR COMMUNICATIONS CIRCUITS

1 PART 1 - GENERAL

PART 1 - GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State Department of Corrections telecommunications projects. This information is provided in specification format to serve as a guide to the Engineer/Designer in producing a CSI-compliant specification that will meet the unique requirements of DOC Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Engineer/Designer may edit this section (adding and/or removing content where required) for use with a particular project, but shall not create a new specification section based on the "intent" of the TCSG, or cut and paste content from TCSG sections into other existing specification sections.
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Text in shaded boxes (such as this text) is included to aid the Engineer/Designer in understanding areas of this Guide Specification that may require modification for a particular project. Although this text is generally written in declarative form, the Engineer/Designer shall consider it guidance only. The Engineer/Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

1.1 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

Review and edit the following list of generic type products and work for relevance to this project. This listing should not include procedures, processes, preparatory work, or final cleaning.

Note that this section is specific to the communications system and shall be included in the Project Manual in addition to 16130 (or equivalent) - Raceway and Boxes for Electrical Circuits. When an Electrical Circuits section and a Telecommunications Circuits section are both in the Project Manual, a statement shall be added to the Raceway and Boxes for Electrical Circuits section similar to the following:
"For Telecommunications Raceway and Boxes, the requirements in Section 16131 - Raceway and Boxes for Telecommunications Circuits shall supercede the requirements in this section where they differ."

A. Provide all materials and labor for the installation of a pathway system for inside plant communications circuits. This section includes requirements for horizontal and building backbone raceways, fittings, and boxes specific to communications circuits (cabling) for voice and data.

B. Related Sections:

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the Contractor's responsibility for coordinating work.

1. Division 16 Section — "Basic Electrical Materials and Methods"
2. Division 16 Section — "Grounding and Bonding for Telecommunications"
3. Division 16 Section — "Inside Plant Communications Circuits"

C. Products furnished (but not installed) under this section:

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. When installations are "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner Installed Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

D. Products installed (but not furnished) under this section -

Include this paragraph only if products will be installed under this section but furnished under other sections or by the Owner. When products are furnished "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner-Furnished Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

1. Grounding Conductors
2. Firestopping Material
3. Labels

E. Provide Unit Prices for:

Include this paragraph only if unit pricing will be required for a specific part of the project. Include statements on how to measure the quantity. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Engineer/Designer shall verify with the DOC PM and/or the DOC IT Specialist assigned to the project whether the latest edition and/or addenda of each required reference is appropriate and shall specify the edition and addenda below accordingly.

A. Incorporate by reference the applicable portions of the following specifications, standards, codes into this specification section.

1. General:
   a. National Electrical Code (NEC)
   b. National Electrical Safety Code (NESC)
   c. Washington Industrial Safety and Health Act (WISHA)

d. Occupational Safety and Health Act (OSHA)

2. Communications:

a. ANSI/TIA/EIA - 568: *Commercial Building Telecommunications Cabling Standard*

b. ANSI/TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*

c. ANSI/TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*

d. ANSI/TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*

e. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*

f. BICSI: *BICSI Telecommunications Cabling Installation Manual*

g. BICSI: *BICSI Telecommunications Distribution Methods Manual (TDMM)*

1.4 DEFINITIONS

Review and edit the following list of definitions for with applicability to this project. Add definitions for unusual terms that are not explained in the Conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Engineer/Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - “Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations”.

Install - “Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations”.

Provide - “To furnish and install, complete and ready for the intended operation”.

A. “EMT shall mean Electrical Metallic Tubing.

B. “RMC” shall mean Rigid Metal Conduit.

C. “Raceway” shall mean any enclosed channel for routing wire, cable or busbars.

D. “TMGB” shall mean *Telecommunications Main Grounding Busbar.* There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.

E. “TGB” shall mean *Telecommunications Grounding Busbar.* There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.

F. “TBB” shall mean *Telecommunications Bonding Backbone.* The TBB is a conductor used to connect TMGBs to the TGBs.

G. “Pullbox” shall mean a metallic box with a removable cover, used to facilitate pulling cable through conduit runs longer than 100’ or in which there are more than 180 degrees of bends.

H. "Junction box" shall mean a pullbox wherein a conduit run transitions from a feeder conduit to multiple distribution conduits.

1.5 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete Raceway system as hereinafter specified and/or shown on the Contract Documents. The Raceway system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in 16740 - Inside Plant Communications Circuits.

B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the Contract Documents but which are necessary to make a complete working Raceway system.

1.6 SUBMITTALS

Review and edit the following list of submittals as applicable to this project. Note that the submittals listed below are specific to this section only. Division 1, Section 01300 (or equivalent) – Submittals should include general administrative requirements (e.g. schedule, number of copies, distribution, etc.). Either Section 01300 or this section should include a statement similar to the following, "The Contractor shall apply Contractor's stamp, sign, or initial certifying that review, verification of required Products, and coordination of information is in accordance with the requirements of the work and Contract Documents.

Any deviations from the Contract Documents or specified product data shall be clearly noted, and must be approved by the Engineer/Designer prior to start of construction. The Engineer/Designer shall obtain approval from DOC through the Alternative Design Request (ADR) process prior to approving a Contractor-submitted deviation.

If the deviation is not approved by the Engineer/Designer it remains the Contractor's responsibility to provide what is required in the Contract Documents".

A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.

1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.

2. For those items noted as allowing "or equal," and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.

3. Provide standard manufacturer's cut sheets and the operating and maintenance (O&M) instructions at the time of submittal review for each device in the system, regardless of whether it is submitted as specified or as an approved equal. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive the materials.

B. Closeout Submittals: Provide submittal information for review as follows:

A telecommunications-specific Operations and Maintenance (O&M) Manual for Communications shall be required for each project. O&M information submitted under this section shall be included in the O&M Manual for Communications and statements should be included in each section directing the Contractor to provide applicable information in the O&M Manual for Communications. The requirement that the Contractor provide an O&M Manual for Communications should be stated in Inside Plant Communications Circuits or in Outside Plant Communications Circuits.

1. O&M Manual for Communications - At the completion of the project, submit all O&M information from product data submittals (above), updated to reflect any changes during the course of construction, to the Engineer/Designer in the telecommunications-specific O&M Manual for Communications binder labeled with the project name and description.

2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.

b. Keep Record Drawings at the job site and make available to the Owner and Engineer/Designer at any time.

c. Keep Record Drawings current throughout the course of construction. (“Current” is defined as not more than one week behind actual construction).

d. Show identifiers for major infrastructure components on Record Drawings.

1.7 CONTRACTOR WARRANTY:

Coordinate this paragraph with the conditions of the contract and Division 1 requirements to ensure that no statements are made that will limit or void those conditions. The Engineer/Designer is required to have a thorough understanding of the manufacturer warranties applicable on this project. The Engineer/Designer shall consider, account for, and advise DOC regarding any unique warranty situations that may arise from Owner-furnished equipment, Owner-installed equipment, or other situations that may conflict with warranty requirements.

A. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.

1. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.

2. The Contractor Warranty period shall commence upon Owner acceptance of the work.

1.8 QUALITY ASSURANCE

A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NEC, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

B. Comply with NECA's "Standard of Installation."

C. Comply with NEC.

1.9 COORDINATION

A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

2 PART 2 - PRODUCTS

PART 2 - PRODUCTS

Ensure that products listed under the PART 2 Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

The products listed in this Guide Specification throughout Part 2 - Products below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by the design are specified with equal or greater detail to the following paragraphs. The Engineer/Designer shall also verify that the most current part number of each specified product is used.

2.1 GENERAL

A. Materials shall consist of conduit, outlet boxes, fittings, enclosures, pull boxes, and other raceway incidentals and accessories as required for inside plant communications circuits.

2.2 MATERIALS

Review and edit the following list of products/part numbers as applicable to this project.

A. Conduit:

1. EMT. 1” minimum conduit size. Flexible metal conduit (FMC) is not acceptable.

   a. Conduit: Galvanized steel tubing meeting ANSI C80.3.

   b. Couplings: Steel, cast iron, or malleable iron compression type employing a split, corrugated ring and tightening nut, with integral bushings and locknuts. Indent-type and setscrew-type couplings are not permitted.

2. RMC. 1” minimum conduit size.

   a. Conduit: Hot dipped galvanized steel with threaded ends meeting ANSI C80.1.

   b. Couplings: Unsplit, NPT threaded steel cylinders with galvanizing equal to the conduit.

   c. Nipples: Same as conduit, factory-made up to 8 inches in diameter, no running threads.

B. Outlet boxes: Minimum 4”x4” size, 2 1/8” minimum depth, with extension rings (if needed) and single gang covers (i.e. mud rings), unless otherwise noted on the Contract Documents. Combined interior depth of outlet box, extension ring and cover shall be a minimum 2-1/2”. Stamped steel, deep drawn one piece (without welds or tab connections), galvanized, with knockouts for 1” trade size conduit or connector entrance, meeting NEMA OS 1.

1. Acceptable manufacturers:

   a. Appleton, Raco, Steel City, or equal

2. Wiremold Extra Deep Switch and Receptacle Box: V5744-2 (two gang)

C. Junction Boxes and Pull Boxes: Stamped steel, deep drawn one piece (without welds or tab connections), galvanized, with knockouts for conduit or connector entrance. Boxes 6”x6”x4” or larger may be code gauge fabricated steel continuously welded at seams and painted after fabrication.

1. Dry locations: meeting NEMA OS 1.

2. Wet locations: NEMA OS 3R.

D. Miscellaneous Fittings:

1. Locknuts and conduit bushings: Malleable iron

a. Appleton, Crouse Hinds, OZ Gedney, or equal

2. Through wall seals and floor seals shall be:

a. OZ Gedney FS and WS series.

E. Pull Strings: Plastic or nylon with a minimum test rating of 200 lb.

Additional products shall be added to the above list as applicable to this project.

If firestopping material is specified in another section, the Engineer/Designer shall reference that section in Part 1 - General above as a related section, and delete the following paragraph in its entirety.

2.3 FIRESTOPPING

A. Material: Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test in a configuration that is representative of the actual field conditions. Manufactured by:

1. Specified Tech. Inc.

Review and edit the following products/part numbers as applicable to this project.

2.4 LABELING AND ADMINISTRATION

A. Labels: As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, typed, and created by a hand-carried label maker or an approved equivalent software-based label making system. Handwritten labels are not acceptable.

1. Hand-carried label maker:

a. Brady: ID Pro Plus (or approved equal).

2. Labels:

a. Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

Additional products shall be added to the above list as applicable to this project.

3 PART 3 - EXECUTION

Ensure that products listed under PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If it is desirable to use other products, the Engineer/Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by the design are specified in Part 2 with corresponding installation requirements specified in Part 3.

3.1 GENERAL

A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.

B. All work shall comply with applicable safety rules and regulations including OSHA and WISHA. All work shall comply with the requirements of the National Electrical Safety Code (NESC) and the NEC except where local codes and/or regulations are more stringent, in which case the local codes and/or regulations shall govern.

C. All work shall comply with the standards, references and codes listed in PART 1 -- REFERENCES above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.

D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.

E. Install the raceway system in a manner ensuring that communications circuits, when installed, are able to fully comply with the ANSI/TIA/EIA and other references listed in Part 1 — References, above.

F. Replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.

G. Remove surplus material and debris from the job site and dispose of legally.

3.2 EXAMINATION

A. Examine surfaces and spaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

Review and edit the following installation requirements based on the products specified in Part 2 above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions. Provide a raceway for each circuit indicated. Do not gang raceway into wireways, pullboxes, junction boxes, etc., without specific approval from the Engineer/Designer. Do not group home runs or circuits without approval from the Engineer/Designer.

B. Conduit:

1. Install EMT unless other conduit is shown on the Contract Documents, is required by Code, or is permitted under these specifications.

2. Install conduit as a complete, continuous system without wires, mechanically secured and electrically connected to metal boxes, fittings and equipment. Blank off unused openings using factory-made knockout seals.

3. Run conduit in the most direct route possible, parallel to building lines. Do not route conduit through areas in which flammable material may be stored.

4. Keep conduit at least 6 inches away from parallel runs of flues and steam or hot-water pipes or other heat sources operating at temperatures above one-hundred degrees Fahrenheit. Install horizontal conduit runs above water piping.

5. Keep conduit away from sources of electromagnetic interference as follows:

   a. For sources less than 220 V_{rms}, keep conduit at least 2 inches away.

   b. For sources greater than 220 V_{rms} and less than or equal to 480 V_{rms}, keep conduit at least 60 inches away.

   c. For sources greater than 480 V_{rms}, keep conduit at least 120 inches away.

6. Do not exceed 90 meters total length for a given conduit run to be used for distribution cabling (from outlet box to telecommunications room), including intermediate conduits and junction boxes.

7. Install conduit exposed, except in finished areas or unless shown otherwise on the drawings. Do not install conduit below grade/slab unless specifically shown on the Contract Documents as being installed below grade/slab.

8. Install exposed conduit in lines parallel or perpendicular to the building or structural members lines except where the structure is not level. Follow the surface contours as much as practical. Do not install crossovers or offsets that can be avoided by installing the conduit in a different sequence or a uniform line.

   a. Run parallel or banked conduits together, on common supports where practical.

   b. Make bends in parallel or banked runs from same centerline to make bends parallel.

9. Conduits concealed above ceilings, furred spaces, etc., which are normally inaccessible may be run at angles not parallel to the building lines.

10. Wherever practical, route conduit with adjacent ductwork or piping and support on common racks. Base required strength of racks, hangers, and anchors on combined weights of conduit and piping.

11. Where conduits cross building expansion joints, use suitable sliding or offsetting expansion fittings. Unless specifically approved for bonding, use a suitable bonding jumper.

    Verify for accuracy the section number and title referenced below.

12. Support conduits as specified in Section 16050 "Basic Electrical Materials and Methods."

    a. Provide anchors, hangers, supports, clamps, etc. to support the conduits from the structures in or on which they are installed. Do not space supports farther apart than five feet.

    b. Provide sufficient clearance to allow conduit to be added to racks, hangers, etc. in the future.

c. Support conduit within three feet of each outlet box, junction box, gutter, panel, fitting, etc.

13. Ream conduits to eliminate sharp edges and terminate with metallic insulated grounded throat bushings. Seal each conduit after installation (until cable is installed) with a removable mechanical-type seal to keep conduits clean, dry and prevent foreign matter from entering conduits.

14. Install a pull string in each conduit.

15. For conduits entering through the floor of a telecommunications room, terminate conduits 4 inches above the finished floor.

16. Do not install communications conduits in wet, hazardous or corrosive locations.

17. Where conduit is shown embedded in masonry, embed conduit in the hollow core of the masonry. Horizontal runs in the joint between masonry units are not permitted.

18. Where conduit is shown embedded in concrete, embed conduit a minimum of two inches from the exterior of the concrete. Do not place conduit in concrete less than five inches thick.

    a. One inch trade size conduit shall be used. Conduits sized larger or smaller than one inch trade size conduit are not permitted embedded in concrete.

    b. Run conduit parallel to main reinforcement.

    c. Conduit crossovers in concrete are not permitted.

19. Where conduit exits from grade or concrete, provide a rigid steel elbow and adapter.

20. Where conduit enters a space through the floor and terminates in that space, terminate the conduit at 4” above the finished floor.

21. Where several circuits follow a common route, stagger pullboxes or fittings.

22. Where several circuits are shown grouped in one box, individually fireproof each conduit.

23. Bend and offset metal conduit with standard factory sweeps or conduit fittings. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

    a. Conduit sweeps:

        1) Sweeps shall not exceed 90 degrees.

        2) Do not exceed 180 degrees for the sum total of conduit sweeps for a section of conduit (between conduit termination points).

        3) Sweep radius shall be at least 10 times the internal diameter of the conduit.

        4) 90-degree condulets (LB’s) and electrical elbows are not acceptable.

    b. Factory-manufactured sweeps are required for bends in conduit larger than 1 inch trade size.

    c. For bends in 1 inch trade size conduit, field-manufactured bends (using a hydraulic bender with a 1” boot) are permitted only when factory-manufactured sweeps are not suitable for the conditions. In all other cases, factory-manufactured sweeps are required. “Hickey-bender” use is prohibited.

24. Connect conduit to hubless enclosures, cabinets and boxes with double locknuts and with insulating type bushings. Use grounding type bushings where connecting to concentric or eccentric knockouts. Make conduit connections to enclosures at the nearest practicable point of entry to the enclosure area where the devices are located to which the circuits contained in the conduit will connect.

25. Penetrations for raceways:

The Engineer/Designer shall consider requiring approval by a licensed Structural Engineer prior to designing penetrations through building structural components.

a. Do not bore holes in floor and ceiling joists outside center third of member depth or within two feet of bearing points. Holes shall be 1-¼ inch diameter maximum.

b. Penetrate finished walls and finished surfaces with a PVC or sheet metal sleeve with an interior diameter (ID) at least 1/4" greater than the outer diameter (OD) of the conduit, set flush with walls, pack with fiberglass, seal with silicone sealant and cover with escutcheon plate.

c. Penetrate poured-in-place walls and free slabs with a cast iron sleeve (or Schedule 40 PVC black pipe sleeve for above-grade only) with retaining ring or washer. Set sleeves flush with forms or edges of slab. Pack around conduit with fiberglass and seal with silicone sealant.

26. Raceway terminations and connections:

a. Join conduits with fittings designed and approved for the purpose and make joints tight. Do not use set indent-type or screw-type couplings.

b. Make threaded connections waterproof and rustproof by applying a watertight, conductive thread compound. Clean threads of cutting oil before applying thread compound.

c. Make conduit terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

d. Cut ends of conduit square using a hand saw, power saw or pipe cutter. Ream cut ends to remove burrs and sharp ends. Where conduit threads are cut in the field, cut threads to have same effective length, same thread dimensions and same taper as specified for factory-cut threads.

e. Provide double locknuts and insulating bushings at conduit connections to boxes and cabinets. Align raceways to enter squarely and install locknuts with dished part against the box. Use grounding type bushings where connecting to concentric or eccentric knockouts.

f. Where conduits are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.

27. Install conduit sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

a. Where conduits pass from warm to cold locations, such as the boundaries of air conditioned or refrigerated spaces and where conduits enter or exit buildings from outdoor areas, including underground ducts or conduit runs.

b. Where otherwise required by the NEC.

28. Prove out each conduit with a minimum 16 inch long test mandrel that is ¼ inch smaller than the inside diameter of the conduit. Repair or replace any conduit that does not prove out at no cost to the Owner.

29. After installation, and within five days of releasing conduit for cabling installation, clean each conduit with a wire brush and swab. Clean each conduit a minimum of two times in the same direction and swab with clean rags until the rag comes out of the conduit clean and dry. Swab away from buildings for conduit sections connected to buildings.

Add conduit product installation requirements to the above information as applicable to this project.

C. Outlet Boxes:

Review and edit the following installation requirements based on the products specified in Part 2 above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

1. Provide outlet boxes and covers as shown on the Contract Documents and as needed. Verify that the appropriate cover type and depth is provided for each type of wall and finish. Provide extension rings as needed.

2. Coordinate box locations with building surfaces and finishes to avoid bridging wainscots, joints, finish changes, etc.

3. Install boxes in dry locations (not wet, corrosive, or hazardous).

4. Attach boxes securely to building structure with a minimum of two fasteners. Provide attachments to withstand a force of one hundred pounds minimum, applied vertically or horizontally.

5. Install boxes at the following heights to the bottom of the box, except where noted otherwise:

   a. Wall mounted telephones: 46 inches above finished floor.

   b. Workstation outlets: 16 inches above finished floor.

   c. Place boxes for outlets on cabinets, countertops, shelves, and similar boxes located above countertops two inches above the finished surface or two inches above the back splash. Verify size, style, and location with the supplier or installer of these items prior to outlet box installation.

6. Recessed mounted outlet boxes:

   a. Recess boxes in the wall, floor, and ceiling surfaces in finished areas. Set boxes plumb, level, square and flush with finished building surfaces within one-sixteenth inch for each condition. Set boxes so that box openings in building surfaces are within one-eighth inch of edge of material cut-out and fill tight to box with building materials. Single gang opening shall extend at least to the finished wall surface and extend not more than 1/8 inch beyond the finished wall surface. Provide backing for boxes using structural material to prevent rotation on studs or joists.

   b. Install floor boxes level and adjust to finished floor surface.

7. Surface mounted outlet boxes:

   a. For boxes surface mounted on finished walls, provide Wiremold outlet box. Cut box as necessary to accept conduit.

   b. For boxes surface mounted on unfinished walls (i.e. electrical rooms, mechanical rooms), provide 4”x4” (minimum) outlet box with single gang cover.

Add outlet box product installation requirements to the above information as applicable to this project.

D. Junction Boxes:

Review and edit the following installation requirements based on the products specified in Part 2 above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

1. Provide junction boxes as shown on the Contract Documents and as required.

   a. Where sizing is not shown on the Contract Documents, size junction boxes as follows:

Maximum Trade Size of Conduit	Width	Box Length	Depth	For Each Additional Conduit Increase Width
1”	4”	16”	3”	2”
1-¼”	6”	20”	3”	3”
1-½”	8”	27”	4”	4”
2”	8”	36”	4”	5”
2-½”	10”	42”	5”	6”
3	12”	48”	5”	6”
3-½”	12”	54”	6”	6”
4”	15”	60”	8”	8”

2. A junction box may not be substituted for a 90-degree bend. *90 degree condulets (LB’s) are not acceptable.*

3. Install junction boxes in an accessible location, readily accessible both at time of construction and after building occupation. Do not install junction boxes in inaccessible interstitial building space.

4. Where junction boxes are to be mounted on ceiling structure above ceiling grid, do not mount higher than 4’ above grid (mount on wall instead).

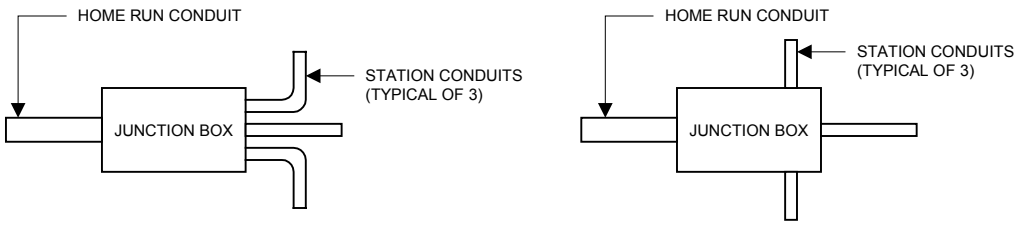
5. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

6. Install junction boxes so that the access door opens from the side where the cable installer will normally work (typically from the bottom, or floor side, of the box).

   a. Where a junction box is installed in a ceiling space, provide full access to the junction box door and adequate working room for both the installation personnel and for proper looping of cable during installation.

   b. Provide a lockable access cover (or junction box door if exposed) in hard pan ceilings.

7. Install junction boxes such that conduit enters and exits at opposite ends of the box as follows:



CORRECT INSTALLATION INCORRECT INSTALLATION

Add junction product installation requirements to the above information as applicable to this project.

E. Pull Boxes:

Review and edit the following installation requirements based on the products specified in Part 2 above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

1. Provide pull boxes as shown on the Contract Documents and as required.

   a. Where sizing is not shown on the Contract Documents, size pull boxes as follows:

Maximum Trade Size of Conduit	Width	Box Length	Depth	For Each Additional Conduit Increase Width
1”	4”	8”	3”	2”
1-¼”	6”	10”	3”	3”
1-½”	8”	12”	4”	4”
2”	8”	16”	4”	5”
2-½”	10”	20”	5”	6”
3	12”	24”	5”	6”
3-½”	12”	28”	6”	6”
4”	15”	32”	8”	8”

   b. Where a pull box is required with conduits 1” trade size or smaller, an outlet box may be used as a pull box. Where outlet boxes are used as pull boxes, the outlet boxes shall be dedicated for use as a pull box and shall not host cable termination hardware.

2. A pull box may not be substituted for a 90-degree bend. *90 degree condulets (LB’s) are not acceptable.*

3. Install pull boxes in an accessible location, readily accessible both at time of construction and after building occupation. Do not install pull boxes in inaccessible interstitial building space.

4. Where pull boxes are to be mounted on ceiling structure above ceiling grid, do not mount higher than 4' above grid (mount on wall instead).

5. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

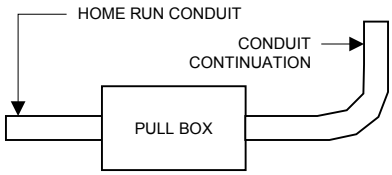
6. Install pull boxes so that the access door opens from the side where the cable installer will normally work (typically from the bottom, or floor side, of the box).

   a. Where a pull box is installed in a ceiling space, provide full access to the junction box door and adequate working room for both the installation personnel and for proper looping of cable during installation.

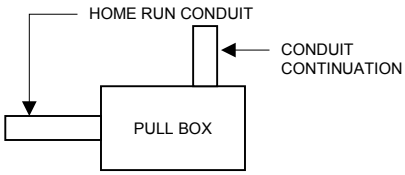
   b. Provide a lockable access cover (or pull box door if exposed) in hard pan ceilings.

7.

8. Install pull boxes such that conduit enters and exits at opposite ends of the box as follows:



CORRECT INSTALLATION



INCORRECT INSTALLATION

Add pullbox product installation requirements to the above information as applicable to this project.

F. Firestopping:

Review and edit the following installation requirements based on the products specified in Part 2 above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

1. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.

2. Maintain fire rating of penetrated fire-rated walls. Firestop and seal each penetration made during construction.

   a. Provide firestopping material for through and membrane penetrations of fire-rated barriers.

   b. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.

   c. Install firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer's recommendations, local fire and building authorities, and applicable codes and standards referenced in PART 1 – REFERENCES. Apply of sealing material in a manner acceptable to the local fire and building authorities.

Add firestop product installation requirements to the above information as applicable to this project.

Review and edit the following installation requirements based on the products specified in Part 2 above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

G. Grounding/Bonding: Grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, and UL 467, ANSI/TIA/EIA standards and the references listed in PART 1 – REFERENCES above, as well as local codes which may specify additional grounding and/or bonding requirements.

1. Bond metallic raceway together and to the nearest TGB (as provided under Division 16 Section — "Grounding and Bonding for Telecommunications"). Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.

Add grounding/bonding product installation requirements to the above information as applicable to this project.

3.4 LABELS:

Review and edit the following installation requirements based on the products specified in Part 2 above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Conduits: Label each conduit end in a clear manner by designating the location of the other end of the conduit (i.e. room name, telecommunications room name, pull box identifier, outlet identifier (use the label of the first port of the outlet as the outlet identifier), etc.). Indicate conduit length on the label.

1. Where a conduit is intended for future cabling use outside of the Contract, the conduit shall be labeled in a clear manner by designating the location of the other end of the conduit (i.e. room name, telecommunications room name, pull box identifier, etc.) along with a sequential number for each spare conduit terminated into a single room. Indicate conduit length on the label.

a. Suggestion: The second spare conduit (whether spare or in use) between Room 100 and telecommunications room 1A might be labeled in the telecommunications room as "Room 100 - #2, __ feet." In Room 100 the same conduit might be labeled "1A - #2, __ feet."

B. Pull Boxes: Label each pullbox with a unique identifier. Identifiers shall be of the form "RN-Y" where "RN" is the room name of the room closest to (or containing) the pull box, and "Y" is the sequential number of the pull box for each "RN".

1. Example: The second pull box in the vicinity of room "100" would have the label "100-2".

C. Pull Strings: Label each pull string in a clear manner by designating the location of the other end of the pull string (i.e. room name, telecommunications room name, pull box identifier, outlet identifier (use the label of the first port of the outlet as the outlet identifier), etc.).

1. Where a pull string is installed in a conduit intended for future cabling use outside of the Contract, the pull string shall be labeled similar to the spare conduit in which it is installed.

Add label product installation requirements to the above information as applicable to this project.

3.5 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and in accordance with accepted industry practice, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.6 CLEANING

1. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

SECTION 16453 – GROUNDING AND BONDING FOR TELECOMMUNICATIONS

SECTION 16453 — GROUNDING AND BONDING FOR TELECOMMUNICATIONS

1 PART 1 - GENERAL

PART 1 - GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State Department of Corrections telecommunications projects. This information is provided in specification format to serve as a guide to the Engineer/Designer in producing a CSI-compliant specification that will meet the unique requirements of DOC Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Engineer/Designer may edit this section (adding and/or removing content where required) for use with a particular project, but shall not create a new specification section based on the "intent" of the TCSG, or cut and paste content from TCSG sections into other existing specification sections.
.

Text in shaded boxes (such as this text) is included to aid the Engineer/Designer in understanding areas of this Guide Specification that may require modification for a particular project. Although this text is generally written in declarative form, the Engineer/Designer shall consider it guidance only. The Engineer/Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

1.1 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this Section.

1.2 SUMMARY

A. Provide all materials and labor for the installation of a grounding and bonding system for communications infrastructure. This section includes requirements for providing a permanent grounding and bonding infrastructure for communications circuits, raceways, and cable tray.

B. Related Sections

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the contractor's responsibility for coordinating work.

1. Division 16 Section — "Basic Electrical Materials and Methods"
2. Division 16 Section — "Raceway and Boxes for Communications Circuits"
3. Division 16 Section — "Inside Plant Communications Circuits"
4. Division 16 Section — "Outside Plant Communications Circuits"

C. Products furnished (but not installed) under this section:

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. When installations are "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner- Installed Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

D. Products installed (but not furnished) under this section -

Include this paragraph only if products will be installed under this section but furnished under other sections or by the Owner. For example, DOC may pre-purchase fiber, but have the Contractor install. When products are furnished "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner-Furnished Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

E. Provide Unit Prices for:

Include this paragraph only if unit pricing will be required for a specific part of the project. Include statements on how to measure the quantity. For example, unit prices may be requested for grounding busbars, grounding conductors, etc. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Engineer/Designer shall verify with the DOC Project Manager and/or the DOC IT Specialist assigned to the project whether the latest edition and/or addenda of each required reference is appropriate and specify the edition and addenda below accordingly.

A. The applicable portions of the following specifications, standards, codes and regulations shall be incorporated by reference into these specifications.

1. General:

a. National Electrical Code (NEC)

b. National Electrical Safety Code (NESC)

c. Washington Industrial Safety and Health Act (WISHA)

d. Occupational Safety and Health Act (OSHA)

2. Communications:

a. TIA/EIA - 568: *Commercial Building Telecommunications Cabling Standard*

b. TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*

c. TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*

d. TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*

e. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*

f. BICSI: *BICSI Telecommunications Cabling Installation Manual*

g. BICSI: *BICSI Telecommunications Distribution Methods Manual (TDMM)*

h. BICSI: *BICSI Customer-Owned Outside Plant Design Manual (CO-OSP)*

1.4 DEFINITIONS

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Engineer/Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - "Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations".

Install - "Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations".

Provide - "To furnish and install, complete and ready for the intended operation".

A. "TMGB" shall mean *Telecommunications Main Grounding Busbar.* There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.

B. "TGB" shall mean *Telecommunications Grounding Busbar.* There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.

C. "TBB" shall mean *Telecommunications Bonding Backbone.* The TBB is a conductor used to connect TMGBs to TGBs.

1.5 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete, permanent Grounding and Bonding infrastructure for communications circuits, raceways, and cable trays as hereinafter specified and/or shown on the Contract Documents. The Grounding and Bonding system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in 16740 - Inside Plant Communications Circuits and 16741 - Outside Plant Communications Circuits.

B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant Grounding and Bonding system.

1.6 SUBMITTAL INFORMATION

Review and edit the following list of submittals as applicable to this project. Note that the submittals listed below are specific to this section only. Division 1, Section 01300 (or equivalent) – Submittals should include general administrative requirements (e.g. schedule, number of copies, distribution, etc.). Either Section 01300 or this section should include a statement similar to the following, "The Contractor shall apply Contractor's stamp, sign, or initial certifying that review, verification of required Products, and coordination of information is in accordance with the requirements of the work and Contract Documents.

Any deviations from the Contract Documents or specified product data shall be clearly noted, and must be approved by the Engineer/Designer prior to start of construction. The Engineer/Designer shall obtain approval from DOC through the Alternative Design Request (ADR) process prior to approving a Contractor-submitted deviation.

If the deviation is not approved by the Engineer/Designer it remains the Contractor's responsibility to provide what is required in the Contract Documents".

A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.

1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.

2. For those items noted as allowing "or equal," and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.

3. Provide standard manufacturer's cut sheets and the operating and maintenance (O&M) instructions at the time of submittal review for each device in the system, regardless of whether it is submitted as specified or as an approved equal. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive the materials.

B. Closeout Submittals: Provide submittal information for review as follows:

A telecommunications-specific Operations and Maintenance (O&M) Manual for Communications shall be required for each project. O&M information submitted under this section shall be included in the O&M Manual for Communications and statements should be included in each section directing the Contractor to provide applicable information in the O&M Manual for Communications. The requirement that the Contractor provide an O&M Manual for Communications should be stated in Inside Plant Communications Circuits or in Outside Plant Communications Circuits.

1. O&M Manual for Communications - At the completion of the project, submit O&M information from product data submittals (above), updated to reflect any changes during the course of construction, to the Engineer/Designer in the telecommunications-specific O&M Manual for Communications binder labeled with the project name and description.

2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.

b. Keep Record Drawings at the job site and make available to the Owner and Engineer/Designer at any time.

c. Keep Record Drawings current throughout the course of construction. (“Current” is defined as not more than one week behind actual construction).

d. Show identifiers for major infrastructure components on Record Drawings.

1.7 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. DOC may choose to construct a project under two bid packages - one for OSP Site Work as described in this specification section as well as other General Contractor specific work, and a second bid package for the Structured Cabling System. The Engineer/Designer must coordinate with DOC to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing, schedules and the use of DOC provided security escorts.

1.8 CONTRACTOR WARRANTY:

Coordinate this paragraph with the conditions of the contract and Division 1 requirements to ensure that no statements are made that will limit or void those conditions. The Engineer/Designer is required to have a thorough understanding of the manufacturer warranties applicable on this project. The Engineer/Designer shall consider, account for, and advise DOC regarding any unique warranty situations that may arise from Owner-furnished equipment, Owner-installed equipment, or other situations that may conflict with warranty requirements.

A. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.

1. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.

2. The Contractor Warranty period shall commence upon Owner acceptance of the work.

2 PART 2 - PRODUCTS

PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

The following paragraphs include products that do not indicate that they allow “or equal” substitutions. If the Engineer/Designer wishes to use other products, an alternative product request shall be submitted in writing to the DOC IT Infrastructure Specialist. This request shall follow the format and procedures of the Alternative Design Request identified in the TDDG, and include detailed literature from the manufacturer of the alternative product. If the alternative product is approved, the Engineer/Designer shall ensure that the specification is written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 - Products below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by the design are specified with equal or greater detail to the following paragraphs. The Engineer/Designer shall also verify that the most current part number of each specified product is listed in this section.

2.1 GENERAL

A. Materials shall consist of busbars, supports, bonding conductors and other incidentals and accessories as required.

2.2 MATERIALS

A. Grounding/Bonding:

1. Telecommunications Main Grounding Bus Bar (TMGB):

a. Large (20” x 4” x ¼”), Pre-drilled: CPI 10622-020

b. Small (10” x 4” x ¼”), Pre-drilled: CPI 10622-010

2. Telecommunications Grounding Bus Bar (TGB):

a. Large (20” x 4” x ¼”), Pre-drilled: CPI 10622-020

b. Small (10” x 4” x ¼”), Pre-drilled: CPI 10622-010

3. Telecommunications Bonding Backbone: #6 AWG insulated (green in color) solid copper conductor.

4. Grounding Conductor: #6 AWG insulated (green in color) solid copper conductor.

Review and edit the following products/part numbers as applicable to this project. If firestopping material is specified in another section, the Engineer/Designer shall ensure that that section is listed in Part 1 - General above as a related section, and delete this paragraph in its entirety.

B. Firestopping material: Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test in a configuration that is representative of the actual field conditions. Manufactured by:

1. Specified Tech. Inc.

Review and edit the following products/part numbers as applicable to this project.

C. Labels: As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.

1. Hand-carried label maker:

a. Brady: ID Pro Plus (or approved equal).

2. Labels:

a. Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

3 PART 3 - EXECUTION

PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If it is desirable to use other products, the Engineer/Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by their design are specified in Part 2 with corresponding installation requirements specified in Part 3.

3.1 GENERAL

A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.

B. All work shall comply with applicable safety rules and regulations including OSHA and WISHA. All work shall comply with the requirements of the National Electrical Safety Code (NESC) and the NEC except where local codes and/or regulations are more stringent, in which case the local codes and/or regulations shall govern.

C. All work shall comply with the standards, references and codes listed in PART 1 -- REFERENCES above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.

D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.

E. Replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.

F. Install the grounding and bonding system in a manner ensuring that communications circuits, when installed, are able to fully comply with the ANSI/TIA/EIA and other references listed in Part 1 — References, above.

G. Remove surplus material and debris from the job site and dispose of legally.

3.2 INSTALLATION

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. The grounding and bonding infrastructure system shall not make use of the building plumbing system, unless required to do so by the NEC.

1. Coordinate the installation of the grounding and bonding system with the electrical power distribution system grounding infrastructure.

B. Ground/Bonding:

1. TMGB: Provide a minimum of one TMGB per telecommunications room for each building and as shown on the Contract Documents. Install TMGB(s) and directly bond TMGB(s) to electrical service ground and to associated TBB(s). Group protector, busbar bonding, and approved building grounding conductors toward the left end and leave space for equipment grounding conductors to the right end.

2. TGB: Provide TGB as shown on the Contract Documents and as required. Directly bond each TGB to it's associated TBB and to the nearest building structural steel or other permanent metallic system. Group protector, busbar bonding, and approved building grounding conductors toward the left end and leave space for equipment grounding conductors to the right end.

3. TBB(s) and Grounding Conductors: Provide TBB(s) and grounding conductors as shown on the Contract Documents and as required to bond all non-current carrying metal telecommunications equipment and materials to the nearest TGB. Use TBB(s) to connect the TMGB to each TGB. Route along the shortest and straightest path possible with minimal bends. Bends shall be sweeping. Insulate TBB(s) and conductors from their support. TBB(s) and grounding conductors shall be continuous (without splices).

   a. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic hardware.

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

C. Firestopping

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

1. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.

2. Maintain the fire rating of all penetrated fire barriers. Fire stop and seal all penetrations made during construction.

   a. Provide firestopping material for through and membrane penetrations of fire-rated barriers.

   b. Install firestops in strict accordance with manufacturer's detailed installation procedures.

   c. Install firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer's recommendations, local fire and building authorities, and applicable codes and standards referenced in PART 1 – REFERENCES. Apply of sealing material in a manner acceptable to the local fire and building authorities.

   d. For demolition work, apply firestopping to open penetrations in fire rated barriers where cable is removed. Apply firestopping regardless of whether or not the penetrations are used for new cable or left empty after construction is complete.

   e. Firestopping material used to seal open penetrations through which cable passes shall be re-usable/re-enterable.

List additional Firestopping product installation requirements above as applicable to this project.

D. Labels:

1. Label TMGB(s) with "TMGB"

2. Label TGB(s) with "TGB".

3. Label TBB(s) and bonding conductors "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

END OF SECTION

SECTION 16740 – INSIDE PLANT COMMUNICATIONS CIRCUITS

SECTION 16740 — INSIDE PLANT COMMUNICATIONS CIRCUITS

1 PART 1 - GENERAL

PART 1 - GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State Department of Corrections telecommunications projects. This information is provided in specification format to serve as a guide to the Engineer/Designer in producing a CSI-compliant specification that will meet the unique requirements of DOC Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Engineer/Designer may edit this section (adding and/or removing content where required), but shall not create a new specification section based on the "intent" of the TCGS, or cut and paste content from TCGS sections into other existing specification sections.

Text in shaded boxes (such as this text) is included to aid the Engineer/Designer in understanding areas of this Guide Specification that may require modification for a particular project. Although this text is generally written in declarative form, the Engineer/Designer shall consider it guidance only. The Engineer/Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

1.1 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this Section.

1.2 SUMMARY

Review and edit the following list of generic type products and for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

A. Provide all materials and labor for the installation of an inside plant telecommunication system. This section includes Inside Plant Communications cabling, termination, and administration equipment and installation requirements for the specified Structured Cabling System (SCS - See Definition Below).

B. Related sections include but are not necessarily limited to the following:

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the contractor's responsibility for coordinating work.

1. Division 16 Section — "Basic Electrical Materials and Methods"
2. Division 16 Section — "Raceway and Boxes for Communications Circuits"
3. Division 16 Section — "Grounding and Bonding for Telecommunications"
4. Division 16 Section — "Outside Plant Communications Circuits"

C. Products furnished (but not installed) under this section:

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. DOC frequently has the Contractor furnish patch cords, but uses their IT staff to install. When installations are "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner- Installed Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

1. Furnish voice and data patch cords specified in Part 2 and Part 3 for installation by DOC personnel.

D. Products installed (but not furnished) under this section -

Include this paragraph only if products will be installed under this section but furnished under other sections or by the Owner. For example, DOC may pre-purchase fiber, but have the Contractor install. When products are furnished "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner-Furnished Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

Consider including paint for backboards, grounding conductors, and any other items that are installed under this section but not furnished under this section.

1. Paint for Backboards

2. Grounding Conductor

E. Provide Unit Prices for:

Include this paragraph only if unit pricing will be required for a specific part of the project. Include statements on how to measure the quantity. For example, unit prices may be requested for duplex outlets, quadruplex outlets, etc. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Engineer/Designer shall verify with the DOC Project Manager and/or the DOC IT Specialist assigned to the project whether the latest edition and/or addenda of each required reference is appropriate and specify the edition and addenda below accordingly.

A. Incorporate by reference the applicable portions of the following specifications, standards, codes into this specification section.

1. General:

a. National Electrical Code (NEC)

b. National Electrical Safety Code (NESC)

c. Washington Industrial Safety and Health Act (WISHA)

d. Occupational Safety and Health Act (OSHA)

2. Communications:

a. ANSI/TIA/EIA - 455: *Fiber Optic Test Standards*

b. ANSI/TIA/EIA - 526: *Optical Fiber Systems Test Procedures*

c. ANSI/TIA/EIA - 568-B: *Commercial Building Telecommunications Cabling Standard*

d. ANSI/TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*

e. ANSI/TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*

f. ANSI/TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*

g. ANSI/TIA/EIA -TSB67: T*ransmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems*

h. ANSI/TIA/EIA -TSB75: *Additional Horizontal Cabling Practices for Open Offices*

i. IEEE 802.3 (series): *Local Area Network Ethernet Standard,* including the IEEE 802.3z *Gigabit Ethernet Standard*

j. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*

k. BICSI*: BICSI Telecommunications Cabling Installation Manual*

l. BICSI*: BICSI Telecommunications Distribution Methods Manual (TDMM)*

1.4 DEFINITIONS

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Engineer/Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - “Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations”.

Install - “Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations”.

Provide - “To furnish and install, complete and ready for the intended operation”.

A. “SCS” shall mean *Structured Cabling System*. The SCS is defined as all required equipment and materials including (but not limited to) ANSI/TIA/EIA 568-B and ISO/IEC 11801 compliant copper station cable (Category 3, Category 5E, Gigaspeed, etc.) and fiber optic cable (multimode and singlemode), patch cables, stations and station connectors, termination blocks, patch panels, racks/enclosures (such as EIA standard equipment racks, enclosures, and vertical and horizontal cable management hardware), pathway/raceway materials (such as conduit, sleeves, D-rings, surface raceway, ladder rack, cable tray, etc.), and other incidental and miscellaneous equipment and materials as required for a fully operational, tested, certified, and warranted system, compliant with all applicable codes and standards.

B. "OSP-SCS" shall mean *Outside Plant - Structured Cabling System*. The OSP-SCS is defined as all required equipment and materials including, but not limited to, ANSI/TIA/EIA and ISO/IEC compliant copper and fiber optic cable (multimode and singlemode), connectors, splices, splice enclosures and other incidental and miscellaneous equipment and materials as required for a fully operational, tested, certified, and warranted system, compliant with all applicable codes and standards.

C. "TMGB" shall mean *Telecommunications Main Grounding Busbar.* There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.

D. "TGB" shall mean *Telecommunications Grounding Busbar.* There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.

E. "TBB" shall mean *Telecommunications Bonding Backbone.* The TBB is a conductor used to connect TMGBs to TGBs.

F. "UTP" shall mean *unshielded twisted pair* cable.

1.5 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating voice, data, and video signals onto a common media, and shall be tested for and be capable of Gigabit Ethernet operation as specified in IEEE 802.3z.

B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant SCS.

1.6 SUBMITTAL INFORMATION

Review and edit the following list of submittals as applicable to this project. Note that the submittals listed below are specific to this section only. Division 1, Section 01300 (or equivalent) – Submittals should include general administrative requirements (e.g. schedule, number of copies, distribution, etc.). Either Section 01300 or this section should include a statement similar to the following, "The Contractor shall apply Contractor's stamp, sign, or initial certifying that review, verification of required Products, and coordination of information is in accordance with the requirements of the work and Contract Documents.

Any deviations from the Contract Documents or specified product data shall be clearly noted, and must be approved by the Engineer/Designer prior to start of construction. The Engineer/Designer shall obtain approval from DOC through the Alternative Design Request (ADR) process prior to approving a Contractor-submitted deviation.

If the deviation is not approved by the Engineer/Designer it remains the Contractor's responsibility to provide what is required in the Contract Documents".

A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.

1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.

2. For those items noted as allowing “or equal,” and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.

3. Provide standard manufacturer’s cut sheets and the operating and maintenance (O&M) instructions at the time of submittal review for each device in the system, regardless of whether it is submitted as specified or as an approved equal. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive the materials.

B. Quality Assurance/Control Submittals: Provide submittal information for review as follows:

1. Submit a cable routing and grouping plan as follows:

a. Where the cable routing and grouping is to be provided as shown on the Contract Documents, do not provide a cable routing and grouping plan. Submit written documentation stating that the cable routing and grouping will be provided as shown on the Contract Documents, that the Contractor has reviewed the routing and grouping on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts between trades, and that the routing and grouping meets applicable codes, regulations and standards.

b. Where changes in cable routing and grouping are proposed, submit complete floor plan(s) and/or detail drawing(s) showing the proposed routing, raceway sizes and locations, and cabling in a manner equal to that of the Contract Documents. Ensure that any cabling changes are coordinated with comparable accommodating changes to the raceway routing and grouping. Specifically note each location where the proposed routing and grouping is different from the Contract Documents. Submit written documentation detailing the reason for each change request. Each change request must be approved in writing by the Engineer/Designer prior to proceeding with the change.

2. Submit wall field termination block and wire management elevations as follows:

a. Where wall field termination blocks and wire management are to be provided as shown on the Contract Documents, do not submit elevations. Submit written documentation stating that the wall field termination blocks and wire management will be provided as shown on the Contract Documents, that the Contractor has reviewed the elevations on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts between trades, and that the elevations meet applicable codes, regulations and standards.

b. Where changes to the wall field termination blocks and wire management are proposed, submit wall field termination block and wire management elevations along with written documentation detailing the reason for the change. The change request must be approved in writing by the Engineer/Designer prior to proceeding with the change.

3. Submit a list of proposed test equipment for use in verifying the installation of the SCS. Proposed test equipment shall meet the criteria as stated in PART 3 – TESTING.

a. Submit for each testing device:

1) Manufacturer and product number.

2) Documentation from the manufacturer showing date and outcome of last re-calibration. Testing device shall have been re-calibrated within the manufacturer's recommended calibration period, encompassing the period of time when the testing device will be used on this project.

3) Documentation from the manufacturer showing software revision. Software revision shall be most current revision available for the device and shall be based upon the most current ANSI/TIA/EIA testing guidelines.

b. Submit proposed copper and fiber cable test forms (see PART 3 – TESTING for more detail).

4. Submit a list of the personnel who will be assigned to the project, the type of work they will be performing per QUALITY ASSURANCE below, and copies of the manufacturer's training certification for each. If personnel changes are made during the project, submit the above information for any new personnel prior to their commencement of work on the project.

C. Closeout Submittals: Provide submittal information for review as follows:

A telecommunications-specific Operations and Maintenance (O&M) Manual for Communications shall be required for each project. O&M information submitted under other related communications sections (e.g. Raceway and Boxes for Communications Circuits, Bonding and Grounding for Communications, etc.) shall be included in the O&M Manual and statements should be included in each section directing the Contractor to provide applicable information in the O&M Manual for Communications. The requirement that the Contractor provide an O&M Manual for Communications should be stated in this section or in Outside Plant Communications Circuits.

1. O&M Manual for Communications - At the completion of the project, submit O&M information from product data submittals (above), updated to reflect any changes during the course of construction, to the Engineer/Designer in the telecommunications-specific O&M Manual for Communications binder labeled with the project name and description.

2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.

b. Keep Record Drawings at the job site and make available to the Owner and Engineer/Designer at any time.

c. Keep Record Drawings current throughout the course of construction. ("Current" is defined as not more than one week behind actual construction).

d. Show identifiers for major infrastructure components on Record Drawings.

Refer to the DOC Telecommunications Distribution Design Guide for format and content of the cable records described below.

e. Provide a table/schedule showing the following information for each cable link in the project on the Record Drawings. Base the table/schedule on the schedule provided by the Engineer/Designer in the Project Manual. Items 1 through 6 and item 8 have already been completed by the Engineer/Designer and are included in the table/schedule. Complete items 7 and 9. Include the following items in the table/schedule:

1) End locations of cable (telecommunications room)

2) Link Type (campus, riser, horizontal)

3) Media type (fiber, Cat 5, Cat 3, etc.)

4) Proposed usage (voice, data, lighting control, etc.

5) Cable Identifier

6) As-designed maximum link length

7) Actual measured link length (from test results)

8) For fiber optic cabling, as-designed maximum link attenuation at design frequency (indicating frequency used for design calculations) including as-designed maximum splice loss and as-designed maximum connector loss

9) For fiber optic cabling, actual measured link attenuation as tested with test frequency (from test results)

10) For copper cabling, actual measured headroom (from test results)

1.7 QUALITY ASSURANCE

The following are DOC requirements for Telecommunications Contractors and Telecommunications Contractor Employees. Review these requirements with the DOC IT Infrastructure Specialist and include as applicable to this project.

For projects that are not being quoted by Contractors on the WA State DIS Master Contract list, consider establishing a deadline prior to the bid date for Contractors to have submitted prequalification documentation demonstrating that they meet the qualification requirements. Also, consider publishing the list of prequalified Contractors as an addendum prior to the bid deadline.

A. Contractor Qualifications: Prior to bidding the project, submit:

1. Documentation from the SCS manufacturer demonstrating that the Contractor is trained and certified by the Manufacturer to install, test, and maintain the SCS and is certified by the SCS Manufacturer to provide the SCS Manufacturer's Warranty (see PART 1 - WARRANTY).

   a. Avaya Communication: SYSTIMAX SCS Installation Contractor (for copper and fiber).

2. Documentation indicating that the Contractor will have only manufacturer-trained and manufacturer-certified employees perform installation, testing, and firestopping work, as detailed below.

3. Documentation demonstrating that the Contractor employs a minimum of one Registered Communications Distribution Designer (RCDD) certified by and in current good standing with BICSI. The RCDD shall be a direct full time employee of the Contractor (i.e. an RCDD consultant/sub-contractor to the Contractor is not acceptable). The document shall also declare that the Contractor will continue to employ a minimum of one RCDD throughout the duration of the project.

4. List of references for no less than five similar projects (in terms of size and construction cost) performed by the Contractor under the Contractor's current business name within the past three years. Detail the following for each project:

   a. Project name and location

b. Construction cost

c. A brief description of the project, the components involved, and the SCS manufacturer used on the project.

d. Number of station drops

e. Customer contact names, phone numbers, and addresses

Include the following paragraph (or one similar) only if the project is to be constructed under the State of Washington Department of Information Services (DIS) Master Contract. Use of the DIS contract shall be discussed with the DOC project manager prior to the completion of Design Development. Pre-qualified Contractors from the DIS list shall be recommended by the Engineer/Designer and the DOC IT Infrastructure Specialist and approved by the DOC project manager. Review and edit the section numbers and titles below and coordinate content as applicable to this project.

5. Documentation demonstrating that the Contractor has a current Master Contract with the State of Washington Department of Information Services (DIS) per the requirements in Section 01010, and shall be on the DOC pre-qualified DIS contractor list shown in Section 01010.

B. Contractor's employees directly involved with the supervision, installation, testing, and certification of the SCS shall be trained and certified by the selected SCS' manufacturer. Training and certifications by employee type are required as shown below:

1. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation and testing.

2. Test Technicians: All (100%) shall be trained/certified for installation and testing.

3. Installation Technicians: All (100%) shall be trained/certified for installation.

4. Other personnel: Personnel not directly responsible for installation supervision, installation, testing or certifying the SCS (i.e. project managers, cleanup crew, etc.) are not required to be manufacturer trained and certified.

C. Contractor's employees whose duties include the application of firestopping material shall be trained and certified by the specified firestopping manufacturer. Training and certifications by employee type are required as shown below:

1. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation.

2. Firestopping Technician: All (100%) shall be trained/certified for installation.

1.8 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing.

A. Provide coordination with Avaya Communication to ensure that Avaya Communication inspectors are available to schedule site visits, inspections, and certification of the system. Provide and coordinate any Avaya Communication-required modifications and have Avaya Communication re-inspect and certify the system prior to the scheduled use of the system by the Owner.

B. The Contractor is solely responsible for all costs associated with scheduling the Avaya Communication inspection, the inspection itself and any Avaya Communication required re-inspections, and for any modifications to the installation as required by Avaya Communication.

1.9 WARRANTY

Coordinate this paragraph with the conditions of the contract and Division 1 requirements to ensure that no statements are made that will limit or void those conditions. The Engineer/Designer is required to have a thorough understanding of the manufacturer warranties applicable on this project. The Engineer/Designer shall consider, account for, and advise DOC regarding any unique warranty situations that may arise from Owner-furnished equipment, Owner-installed equipment, or other situations that may conflict with warranty requirements.

A. Contractor Warranty:

1. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.

a. Provide all labor attributable to the fulfillment of this warranty at no cost to the Owner.

1) The Contractor Warranty period shall commence upon Owner acceptance of the work.

B. SCS Manufacturer Warranty:

1. Provide a SCS Manufacturer extended product, performance, application, and labor warranty that shall warrant all passive components used in the SCS. Additionally, this warranty shall cover components not manufactured by the SCS Manufacturer, but approved by the SCS Manufacturer for use in the SCS (i.e. “Approved Alternative Products”). The SCS Manufacturer warranty shall warrant:

a. That the products will be free from manufacturing defects in materials and workmanship.

b. That the cabling products of the installed system shall exceed the specification of ANSI/TIA/EIA 568-B and exceed ISO/IEC 11801 standards.

c. That the installation shall exceed the specification of ANSI/TIA/EIA 568-B and exceed ISO/IEC 11801 standards.

d. That the system shall be application independent and shall support both current and future applications that use the ANSI/TIA/EIA 568-B and ISO/IEC 11801 component and link/channel specifications for cabling.

2. Provide materials and labor attributable to the fulfillment of this warranty at no cost to the Owner.

3. The SCS Manufacturer Warranty shall be provided by the selected SCS Manufacturer and shall be:

a. Avaya Communication SYSTIMAX Structured Connectivity Solution Extended Product Warranty and Application Assurance Program (20 Years).

1) Provide a copy of the SYSTIMAX Registration Document to the Owner at the time of submittal to Avaya.

4. The SCS Manufacturer Warranty period shall commence upon a Warranty Certificate being issued by the manufacturer. The Warranty Certificate shall be issued no later than three months after Owner acceptance of the work.

2 PART 2 - PRODUCTS

PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

DOC has standardized on Avaya Communication for all new Structured Cabling Systems in DOC facilities. Products shall be specified accordingly. The Engineer/Designer shall ensure that the latest Avaya part numbers are used for specified products. "Or-Equal" substitutions for Avaya products are not permitted.

Some of the following paragraphs include ancillary products (such as racks, cable supports, etc.) manufactured by companies other than Avaya Communication, but do not indicate that they allow "or equal" substitutions. If the Engineer/Designer wishes to use other products in lieu of non-AVAYA ancillary products, an alternative product request shall be submitted in writing to the DOC IT Infrastructure Specialist. This request shall follow the format and procedures of the Alternative Design Request identified in the TDDG, and include detailed literature from the manufacturer of the alternative product. If the alternative product is approved, the Engineer/Designer shall ensure that the specification is written with equal or greater detail to the following paragraphs.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by their design are specified with equal or greater detail to the following paragraphs. The Engineer/Designer shall also verify that the most current part number of each specified product is listed in this section.

2.1 GENERAL

A. Unless specifically stated as "Or equal", equivalent items are not acceptable, provide items as specified.

B. Physically verify existing site conditions prior to purchase and delivery of the materials, including but not limited to lengths of conduit and/or pathway to be used for routing backbone cabling. Pre-cut materials of insufficient length are the sole responsibility of the Contractor.

C. SCS components shall be manufactured by a single manufacturer. Components shall not be intermixed between different manufacturers unless the manufacturer of the SCS has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the SCS Manufacturer Warranty (see PART 1 - WARRANTY).

1. Bid only one SCS Manufacturer and only bid a manufacturer for which the Contractor is certified. The SCS Manufacturer shall be the following. Substitution is not acceptable:

    a. Avaya Communication

D. For a given manufacturer, all components shall be part of a single SCS product line – components shall not be intermixed between a manufacturer's SCS product lines. The SCS product line shall be engineered "end-to-end" – the system and all of it's components shall be engineered to function together as a single, continuous transmission path.

1. The SCS Product Line shall be the following, per manufacturer. Substitution is not acceptable:

    a. For Avaya:

        1) For Category 6 Copper Distribution: SYSTIMAX SCS GigaSPEED

2) For Fiber Distribution: SYSTIMAX SCS OptiSPEED

E. Racks, rack cable distribution hardware, ladder rack, and other rack and distribution components shall be manufactured by a single manufacturer unless stated otherwise in this Specification or in the Contract Documents. Do not intermix equipment and components between different manufacturers.

1. Rack/Distribution Equipment: Chatsworth Products, Inc. (CPI)

2. Wall-mount Racks and Cabinets:

a. Chatsworth Products, Inc. (CPI)

b. Rittal Corporation

c. Hubbell

d. Wright Line

F. Provide all incidental and/or miscellaneous hardware not explicitly specified or shown on the Contract Documents that is required for a fully operational, tested, certified and warranted system.

2.2 PATHWAYS AND CABLE SUPPORTS

Review and edit the following products/part numbers as applicable to this project.

A. Installation and materials for the raceway and boxes for the SCS shall be as specified under Division 16 Section — “Raceways and Boxes for Communications Circuits” except where noted below.

B. Surface Metal Raceway (SMR): UL listed under Section 5 with fittings including (but not limited to) mounting clips and straps, couplings, internal and external elbows, cover clips, bushings, end fittings, outlet boxes and other incidental and miscellaneous hardware required for a complete Surface Raceway system.

1. Wiremold w/Category 5 fittings.

C. Backboards: ¾ inch A-C non-fire-retardant plywood backboards, void free, 2440-mm (8-ft) high unless otherwise noted.

D. C-Rings:

1. Composite: CPI 12035

E. D-Rings:

1. Composite: CPI 12127, 10812

2. Metallic: CPI 10941, 10942, 10943

F. Cable Supports (J-Hooks, Straps): Complete with incidental materials and assemblies required for mounting.

1. CADDY CableCat Wide Base Cable Supports (J-Hooks):

a. CAT12 (up to 16 4-pair/2-strand UTP/fiber cables)

b. CAT21 (up to 50 4-pair/2-strand UTP/fiber cables)

c. CAT32 (up to 80 4-pair/2-strand UTP/fiber cables)

2. CADDY CableCat Adjustable Cable Supports (Straps):

a. CAT425 (up to 425 4-pair/2-strand UTP/fiber cables)

G. Ladder Rack: Complete with fittings including (but not limited to) splice kits, cable radius drop, radius bends, protective end caps, retaining posts, support brackets, foot kits, vertical wall brackets, wall angles, grounding hardware and other incidental and miscellaneous hardware required for a complete ladder rack system. Ladder rack components shall be manufactured by the selected Rack/Distribution Equipment manufacturer.

1. Unless otherwise indicated, all ladder rack and incidental equipment color shall be:

a. Gray

2. Ladder rack:

a. For CPI: Universal Cable Runway 10250-xxx

3. Horizontal radius bends:

a. For CPI: Cable Runway E-Bend 10822-xxx

4. Cable Retaining Posts:

a. For CPI: 10596-108

5. Radius Drops:

a. For CPI: 1210x-xxx

6. Ladder rack/cable runway Grounding kits:

a. For CPI: 12061-001

Verify the size of innerduct required for the project and modify paragraph below accordingly.

H. Innerduct: 1 ¼" Outside Diameter, bright orange in color.

I. Pull Strings: Plastic or nylon with a minimum test rating of 200 lb.

List additional raceway products above as applicable to this project.

2.3 FIRESTOPPING

Review and edit the following products/part numbers as applicable to this project. If firestopping material is specified in another section, the Engineer/Designer shall ensure that that section is listed in Part 1 - General above as a related section, and delete this paragraph in its entirety.

A. Firestopping material: Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test in a configuration that is representative of the actual field conditions. Manufactured by:

1. Specified Tech. Inc. (or approved equal).

List additional firestopping products above as applicable to this project.

2.4 EQUIPMENT RACKS/ENCLOSURES

Review and edit the following products/part numbers as applicable to this project.

A. Unless otherwise indicated, equipment racks/enclosures and incidental equipment color shall be:

1. Clear aluminum

2. Black

B. Unless otherwise indicated, equipment rack/enclosure/wall-mounted brackets and incidental materials and equipment shall be provided by the selected Rack/Distribution Equipment manufacturer. Do not intermix products from different manufacturers.

C. Provide each equipment rack, equipment frame, cabinet, and wall-mount bracket (set) with the following:

1. Free Standing Equipment Racks: EIA-standard 7-foot high x 19-inch wide racks with universal alternating hole pattern, complete with top angles, self-supporting bases, and mounting holes on both sides of the rails.

a. Racks:

1) For CPI: Standard Rack 55053-x03

2) For CPI: Universal Rack 46353-x03

b. Wide (6 inches) double-sided cable channels for vertical cable management:

1) For CPI:

a) Double-sided: 11729-x03

c. Guard rail:

1) For CPI: 40056-x19 (7 inches deep)

d. Cable Support Bars: 5” deep:

1) AMP 557548-1 (or approved equal)

2. Free Standing Equipment Frames (double rails): EIA-standard 7-foot high x 19-inch wide equipment frames with universal alternating hole pattern and with rails in front and back (4 posts), complete with top angles, self-supporting bases, and top and bottom extension pans.

a. Frames:

1) For CPI: 50130-x03

The Engineer/Designer shall take care to coordinate the locations of floor-mounted power outlets with the space between the base plates of adjoining double-rail racks to avoid superimposing the base plates over the power outlets.

b. Wide (6 inches) double-sided cable channels for vertical cable management:

1) For CPI:

a) Double-sided: 11729-x03

c. Guard rail:

1) For CPI: 40056-x19 (7 inches deep)

d. Cable Support Bars: 5” deep:

1) AMP (or equal) 557548-1

3. Wall-mount Swing Gate Equipment Racks: EIA-standard 19-inch wide, hinged, wall-mount swing gate racks with universal alternating hole pattern.

a. Swing gate racks:

1) For all buildings requiring wall mount racks, racks shall be 35 inches high (20U), 24 inches deep:

a) For CPI: Universal Swing Gate Rack equal to Special Order model #SK2680 (3 feet high, 22 inches deep), but shall be 24 inch deep model (or approved equal).

2) Each rack shall be provided with:

a) Jumper rings/loops for vertical cable management:

i. For CPI: 1307 (or approved equal)

b) Cable Support Bars: 5” deep :

i. AMP 557548 (or approved equal)

4. Wall-mount Rack Enclosures/Cabinets: EIA-standard 19-inch wide (interior rack dimension), dual locking hinge (for front and back access), wall-mount rack enclosures/cabinets with universal alternating hole pattern. Complete with fan/filter kit for cooling, with mounting holes on both sides of the rails, and a metallic, lockable door.

a. For CPI:

1) 41 inches high (20U), 24 inches deep: 11685-719

b. For Rittal:

1) 18.82 inches high (9 U), 24 inches deep: 7709.635

2) 29.37 inches high (15 U), 24 inches deep: 7715.635

3) 39.84 inches high (21 U), 24 inches deep: 7721.635

c. Or approved equal.

5. Hinged Wall-mount Brackets: EIA-standard 19 inch wide, hinged, wall-mount brackets:

a. For CPI:

1) 3.50 inches (2U) high, 4 inches deep: 1152 1-704 (black)

2) 5.25 inches (3U) high, 4 inches deep: 1152 2-704 (black)

3) 7.00 inches (4U) high, 4 inches deep: 1152 3-704 (black)

4) 10.5 inches (6U) high, 4 inches deep: 1152 5-704 (black)

b. Or approved equal.

6. Flush Mounted Wall Brackets: EIA standard universal 19 inch wide, 2U, flush wall mount brackets:

Please note that the weight limit for the following CPI flush-mounted wall bracket is 75 pounds. For larger loads, select and specify an appropriate bracket.

a. For CPI: 11583-x19

7. Single sided vented shelf:

   a. For CPI: 40117-x19

8. 120 VAC / 15 Ampere power strip:

   a. For Free Standing Equipment racks: Complete strip (72" in length) with mounting hardware to mount to back of cable management channel and/or standoff brackets to mount to back of rack:

      1) For CPI: 12x70-701 (or approved equal)

   b. For wall-mounted equipment racks/enclosures/bracket (sets): Rack-mountable, surge protecting, with On/Off switch:

      1) For Homaco: PS-19-15A-xxx (or approved equal)

Coordinate with DOC personnel to determine if shelves, drawers or other rack accessories are desired/required.

9. Grounding kit and #6 AWG insulated copper conductor grounded to the nearest TGB.

   a. For CPI: CPI grounding kit

10. Incidental materials required for proper construction, mounting and securing.

List additional Equipment Racks/Enclosure products above as applicable to this project.

2.5 GROUNDING AND BONDING

Review and edit the following products/part numbers as applicable to this project.

A. As specified under Division 16 Section – "Grounding and Bonding for Telecommunications."

List additional Grounding and Bonding products above as applicable to this project.

2.6 PATCH PANELS

Review and edit the following products/part numbers as applicable to this project.

A. Copper Patch Panels: Complete with pre-manufactured cable management for supporting station cable behind the patch panel, and with incidental materials necessary for mounting. Unless otherwise indicated, copper patch panels shall be manufactured by the selected SCS Manufacturer.

1. For Horizontal Distribution: Shall exceed Category 6 (draft) transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801:

   a. For Avaya:

      1) RJ-45:

         a) 24 Port – PATCHMAX GigaSPEED – PM2160-24GS (wired for T568B)

         b) 48 Port – PATCHMAX GigaSPEED – PM2160-48GS (wired for T568B)

   b. Avaya 110 VisiPatch System with associated components.

B. Fiber Patch Panels: Pre-assembled enclosures with connector panels, blank connector panels (for unused connector panel slots), and strain relief, complete with fiber connectors and fiber optic receptacle adapters (see CONNECTORS below), and with incidental materials necessary for mounting. Fiber patch panels shall be manufactured by the selected SCS Manufacturer:

1. For Backbone Distribution:

a. For Avaya:

1) Rack mounted patch panels (2U to 4U, 6 to 72 duplex ports):

a) LGX Fiber Optic Distribution Shelf

b) 600B Fiber Optic Sliding Combo Shelf complete w/jumper support, troughs, cover, etc.

2) Wall-mounted patch panels (6 to 24 duplex ports):

a) Lightguide Interconnection Unit (LIU)

i. Connectors: Duplex SC (see CONNECTORS below)

ii. Connector panels: Duplex SC (high-density)

2. Patch Panel Horizontal Wire Management: Shall be manufactured by the selected SCS Manufacturer:

a. For Avaya:

1) 1.75 inch (1U): 1100D3

2) 3.5 inch (2U): 1100D2

List additional Patch Panel products above as applicable to this project.

2.7 CONNECTORS

Review and edit the following products/part numbers as applicable to this project.

A. Copper Connectors (modular jacks): 8-position/8-conductor, insulation displacement connection (IDC), non-keyed, and shall accept modular 8-position/8-conductor plugs, complete with multicolored identification labels/icons for identification, and with a universally color-coded wiring pattern for both T568A and T568B. Copper connectors shall be manufactured by the selected SCS Manufacturer.

1. Horizontal Distribution:

Include connector information for each type of connector to be used on the project. Review the type of inmate phone system termination and coordinate with the correct connector type (green in color) if any.

a. Category 3 (for Inmate Phone System): None required.

b. Category 5e: Gigaspeed connectors (see below).

c. Gigaspeed: Shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801, and shall be part of the UL LAN Certification and Follow-up Program:

1) For AvayaGigaSPEED MGS300 (yellow)

B. Fiber Connectors: Complete with fiber optic receptacle adapters where required for mounting.

1. For Horizontal Distribution:

   a. For Multimode: 62.5/125 µm, duplex SC for multimode fiber, epoxyless with a zirconia ceramic ferrule, beige:

      1) For Avaya: SC Fiber Optic Connector P620xA-Z-126

2. For Backbone Distribution:

   a. For Multimode: 62.5/125 µm, duplex SC for multimode fiber, epoxyless with a zirconia ceramic ferrule, beige:

      1) For Avaya: SC Fiber Optic Connector P620xA-Z-126

   b. For Singlemode: Duplex SC, for singlemode fiber with a one-piece design with a zirconia ceramic ferrule, blue:

      1) For Avaya: SC Fiber Optic Connector P600xA-Z-125

List additional Connector products above as applicable to this project.

2.8 COPPER TERMINATION BLOCKS

Review and edit the following products/part numbers as applicable to this project.

A. Copper Termination Blocks: UL listed and exceed ANSI/TIA/EIA 568-B Gigaspeed specifications for performance. Include connecting blocks, designation strips, and labels for each 25-pair strip. Label colors per ANSI/TIA/EIA standards. Termination blocks shall be manufactured by the selected SCS Manufacturer:

1. For Wall-mounted:

   a. For Avaya:

      1) Blocks: 110 Wiring Blocks

         a) With Legs: 110AW2-100 (100-pr), 110AW2-300 (300-pr)

         b) Without Legs: 110DW2-100 (100-pr), 110DW2-300 (300-pr)

      2) Designation strips: 188UT1-50

      3) Labels: 110xxx-4500L

      4) IDC Connecting Blocks

         a) For Horizontal Distribution: 4-pair markings, 110C-4

         b) For Backbone Distribution: 5-pair markings, 110C-5

2. For Mounting on Backboards:

   a. For Avaya:

      1) Jumper Trough: 110A3

      2) Distribution Ring Backboard: 188B2

3. For Mounting on Racks:

   a. Jumper Troughs:

1) For Avaya: 110B3

b. Brackets:

1) 100-PR (3U): Avaya 110RD2-100-19

2) 200-PR (4U): Avaya 110RD2-200-19

List additional Copper Termination Block products above as applicable to this project.

2.9 STATIONS

Review and edit the following products/part numbers asapplicable to this project.

A. Faceplates: Complete with port identification labels and blank inserts/fillers for covering unused connector openings:

1. Stations to be used for wall-mount telephones: Brushed stainless steel with stainless steel mounting lugs suitable for supporting wall-mount telephones:

a. HUBBLE, SUTTLE, or approved equal.

2. Inmate phone stations: None.

3. Security Faceplates:

a. For HUBBLE: SWP8 (single gang) or SWP82 (double gang) and associated mounting strap

4. All other stations: Brushed stainless steel:

a. For Avaya: MxxSP Series. “Angled” faceplates are not acceptable.

5. Security Screws: Torx Tamper-Resistant Head

B. Faceplate Mounting Brackets: Suitable for mounting faceplates over wall cutouts (i.e. flush-mount faceplates with no in-wall outlet box).

1. For CADDY:

a. Single gang faceplates: CADDY MP1P

b. Double gang faceplates: CADDY MPAL2

List additional Station products above as applicable to this project.

2.10 CABLE

Review and edit the following products/part numbers as applicable to this project.

A. General: Cables shall be manufactured by the selected SCS Manufacturer.

B. Copper Cable:

1. For Horizontal Distribution: 4-pair, UTP, 24 AWG, with solid copper conductors and shall be part of the UL LAN Certification and Follow-up Program.

a. Category 3:

1) For Avaya:

a) Plenum: 2010

b) Non-plenum: 1010

b. Gigaspeed: Shall exceed Category 6 (draft) transmission requirements as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801:

The Engineer/Designer shall select a color for CAT 6 cabling that matches any existing CAT 6 cabling at the facility, or that is a unique color used only for CAT 6 cabling. Note that the Outside Diameter of 1081 and 2081 cable is greater than 1071 and 2071 due to the strength member. Calculate fill and size raceways accordingly.

1) For Avaya:

a) Plenum: GigaSPEED – 2081

b) Non-plenum: GigaSPEED – 1081

DOC does not generally allow the use of OSP rated cable in the horizontal data environment. If a design solution (approved by DOC) requires the use of OSP rated Category 5e/6, then include the following paragraph (Note that Avaya presently makes only a CAT-5 rated cable). An alternative DOC-approved OSP CAT-5e/6 cable should be specified.. The Entrance Protector for this application is specified in the Outside Plant Communications Circuits section.

c. OSP Rated Category 5E/6: Outdoor rated, shall exceed Category 5E transmission requirements as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801:

1) For Avaya:

a) OSP: xxxxxxxx (or approved alternative)

2. For Backbone Distribution:

a. Copper Backbone Cable: Shielded, 24-AWG solid copper conductor, and insulated with color coded PVC, UL Verified to ANSI/TIA/EIA 568-B for Category 3 performance. Cable shall be manufactured by the selected SCS Manufacturer:

1) For Avaya: ARMM Riser Cable

b. For Termination Block Connections (back-side): Unshielded, non-plenum multi-pair copper cable.

c. Multi-pair Copper Cable: 24-AWG, solid copper conductor, and insulated with color coded PVC, UL Verified to ANSI/TIA/EIA 568-B for Category 3 performance. Cable shall be manufactured by the selected SCS Manufacturer:

1) For Avaya: Category 3 1010

C. Fiber Cable:

1. For Horizontal Distribution:

a. For Multimode: Multimode, graded index, tight-buffered, 2-strand fiber optic cable.

1) For 62.5/125 µm: Maximum attenuation of 3.5 dB/km @ 850 nm and 1.0 dB/km @ 1300 nm and minimum cable bandwidth of 200 MHz/km @ 850 nm and 500 MHz/km @ 1300 nm. Cable shall be manufactured by the selected SCS Manufacturer:

a) For Avaya:

i. Plenum: ACCUMAX OptiSPEED

ii. Non-plenum: ACCUMAX OptiSPEED

2. For Backbone Distribution:

a. For Multimode: Graded index, tight-buffered cable.

1) For 62.5/125 µm: Extended/high grade with a maximum attenuation of 3.5 dB/km @ 850 nm and 1.0 dB/km @ 1300 nm and a minimum cable bandwidth of 200 MHz/km @ 850 nm and 500 MHz/km @ 1300 nm. Cable shall be manufactured by the selected SCS Manufacturer:

a) For Avaya:

i. Plenum: ACCUMAX OptiSPEED

ii. Non-plenum: ACCUMAX OptiSPEED

b. For Singlemode: Tight-buffered with a maximum attenuation of 0.4 dB/km @ 1300 nm and 0.3 dB/km @ 1550 nm. Cable shall be manufactured by the selected SCS Manufacturer and shall be:

1) For Avaya:

a) Plenum: ACCUMAX OptiSPEED

b) Non-Plenum: ACCUMAX OptiSPEED

c. For Hybrid/Composite: Multimode and singlemode characteristics and specifications shall conform to the above requirements. Cable shall be manufactured by the selected SCS Manufacturer and shall be:

1) For Avaya:

a) Plenum: ACCUMAX OptiSPEED

b) Non-Plenum: ACCUMAX OptiSPEED

List additional Cable products above as applicable to this project.

2.11 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

Review and edit the following products/part numbers as applicable to this project.

A. Velcro Cable Managers: Reusable (Velcro based) hook and loop style, adjustable tension, roll or spool dispensed:

1. SIEMON VCM-xxxx-xxx (or approved equal)

Patch cables will generally be furnished by the Contractor and delivered to DOC IT personnel at the facility for installation. DOC personnel shall determine lengths of patch cables and colors. Note that patch cable color for inmate LANs shall be green, no other patch cables shall be green in color.

B. Copper Patch Cables: Pre-manufactured (factory-terminated), stranded unshielded twisted pair (UTP), with 8-pin modular plugs and/or termination block-style patch plugs. Patch cables shall be manufactured by the selected SCS Manufacturer.

1. For Horizontal Distribution:

a. Gigaspeed: Shall exceed Category 6 transmission as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801. Modular plugs shall be complete with snagless boots.

1) Modular-to-modular plugs (8-pin to 8-pin): Avaya GigaSPEED D8GS

2) Patch-to-modular plugs (110 to 8-pin): Avaya

b. Avaya VisiPatch Patch Cords

C. Fiber Patch Cables: Pre-manufactured (factory-terminated) with a UL rating of OFNR. Fiber patch cables shall be manufactured by the selected SCS Manufacturer.

1. For Backbone Distribution:

a. For Multimode: 62.5/125 µm, duplex:

1) For SC-to-SC: Avaya ML2SC-SC-xx

2) For SC-to-MTRJ: Avaya ML2SC-MJ-xx.

b. For Singlemode:

1) For SC-to-SC: Avaya MS2SC-SC-xx

D. Copper Jumper Wire: Category 3 (for cross connects), manufactured by the selected SCS Manufacturer.

List additional Cable products above as applicable to this project.

2.12 LABELING AND ADMINISTRATION

Review and edit the following products/part numbers asapplicable to this project.

A. Labels:

1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.

a. For Station Cable:

1) Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

b. For Backbone Cable:

1) Panduit Marker Tie (or approved equal)

B. Hand-carried label maker:

1. Brady: ID Pro Plus (or approved equal).

List additional Labeling products above as applicable to this project.

3 PART 3 - EXECUTION

PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

DOC has standardized on Avaya Communication for all new Structured Cabling Systems in DOC facilities. Installation requirements shall be specified accordingly.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Engineer/Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by the design are specified in Part 2 with corresponding installation requirements specified in Part 3.

3.1 GENERAL

A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.

B. All work shall comply with applicable safety rules and regulations including OSHA and WISHA. All work shall comply with the requirements of the National Electrical Safety Code (NESC) and the NEC except where local codes and/or regulations are more stringent, in which case the local codes and/or regulations shall govern.

C. All work shall comply with the standards, references and codes listed in PART 1 -- REFERENCES above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.

D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.

E. Replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.

F. Remove surplus material and debris from the job site and dispose of legally.

3.2 DEMOLITION

Review any demolition requirements for this project with the DOC project manager and edit the following paragraph as applicable.

A. Demolish existing telecommunications equipment, cable, materials, and incidentals no longer in use after installation of and cutover to the new SCS.

1. Remove all materials demolished by the Contractor from the site and dispose of properly and legally.

B. When demolishing existing surface plastic/metal raceway, patch and/or paint wall to match existing undisturbed wall finish after raceway is removed.

3.3 RACEWAY

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Surface Raceway: Provide for all surface mounted stations as shown in the Contract Documents.

1. Size surface raceway according to the quantity of cable to be routed through it according to ANSI/TIA/EIA 569 cable capacity standards, plus an additional 100% for future expansion. Size fittings/bends to accommodate Category 5/6 and fiber optic bend radii as specified in ANSI/TIA/EIA 569.

2. Match surface raceway finish as close as possible to the finish of the wall it is to be mounted on but do not paint surface raceway. Surface raceway shall be:

    a. Installed per Article 352 of the NEC. Surface raceway shall be installed as mechanically and electrically continuous and bonded in accordance with NEC and ANSI/TIA/EIA 607 codes and standards.

    b. Installed according to ANSI/TIA/EIA standards for fiber optic and Category 5/6 bend radii. Bend points shall have a minimum two inch radius control.

    c. Securely supported using screws or other anchor-type devices (tape or glue is not an acceptable support medium) at intervals not exceeding 5 feet and with no less than two supports per straight raceway section. Surface raceway shall be supported in accordance with the manufacturer's installation requirements.

    d. Completely installed including insulating bushings and inserts where required by manufacturer's installation requirements.

    e. Installed parallel and perpendicular to surfaces or exposed structural members, and following surface contours where possible.

    f. Close any unused raceway openings.

B. Backboards: Provide backboards as shown on Contract Documents. Backboards shall be capable of supporting attached equipment, and painted with a minimum of two coats (over primer) of fire retardant, non-conductive paint, and one coat of white colored semi gloss top coat paint. Mount A-C plywood backboards with the "A" side exposed.

C. Sleeves: Provide sleeves where required for cable pass-thru through building structures and/or fire rated barriers. Provide roto-hammering or core drilling where required for sleeve installation. Seal (and if a fire rated barrier, firestop) between sleeve and building structure and/or barrier. Size sleeves:

    1. As noted in the Contract Documents.

    2. Where not noted, size sleeves a minimum of 2 inches in diameter or by the type and quantity of cable to be routed through the sleeve per ANSI/TIA/EIA 569 cable capacity standards plus an additional 100% for future expansion - whichever is greater.

D. C-Rings: Provide C-Rings mounted at 6 inch intervals and as shown in the Contract Documents.

E. D-Rings: Provide D-Rings as necessary to route exposed cables in telecommunications rooms and on backboards and for raceway for routing cable in non-exposed open access environments, and as shown in the Contract Documents. D-Rings may be affixed to wall/ceiling structures or other supports, but not attached to a ceiling support system. In telecommunications rooms, mount D-Rings at 12 inch intervals and as shown in the Contract Documents. Mount D-rings used for raceway in open access environments at 4 foot intervals unless otherwise specified in the Contract Documents.

    1. Size D-Rings as noted in the Contract Documents.

    2. Where not noted, size D-Rings according to the type and quantity of cable to be routed through the ring per TIA/EIA 569 cable capacity standards, plus an additional 100% for future expansion, but not less than a minimum of 2 inches in diameter.

F. Cable Supports (J-Hooks, Straps): Provide cable supports for routing cable in non-exposed open access environments as shown in the Contract Documents. Cable supports may be affixed to wall/ceiling structures or other supports, but not attached to a ceiling support system. Mount cable supports at 4 foot intervals unless otherwise specified in the Contract Documents. Do not use cable supports for more cables than they were designed to support. Provide multiple cable supports where

the total cable count exceeds the maximum cable count for which the support was designed. Size according to the type and quantity of cable to be routed through the ring per ANSI/TIA/EIA 569 cable capacity standards, plus an additional 50% for future expansion.

G. Ladder Rack: Install ladder rack per manufacturer's instructions with flat (rung) side up. Provide ladder rack to affix tops of racks to walls, to route cable from walls to racks within telecommunications rooms, and in locations shown in the Contract Documents. Size and install as shown in the Contract Documents. Cut ends of ladder rack square. Ream cut ends to remove burrs and sharp edges. Cap cut ends with manufacturer's recommended caps. Mount retaining posts as required. Provide Cable Radius Drops wherever cable is to drop from one section of ladder rack to another lower section of ladder rack or onto racks or cabinets.. Provide 90-degree horizontal radius bends for each 90-degree change in direction of ladder rack angle. Provide Cable Retaining Posts for all sides of ladder rack within a telecommunications room not directly adjacent to a wall. Affix posts at 2 foot centers and at corners and/or junctions. Provide Cable Runway Grounding kits across ladder rack splices and where ladder racks end at or are connected to racks/cabinets.

H. Innerduct: Provide bright orange innerduct as pathway for backbone fiber optic cables (backbone only – not station cables), from backbone fiber patch panels to conduit or plenum entrances, and as shown in the Contract Documents. Innerduct installed in plenum rated environments shall be plenum rated.

I. Pull Strings: Provide a pull string in existing conduits that are to remain vacant after existing cable is demolished and in existing and new conduits that have new cable installed under this project.

List additional Raceway product installation requirements above as applicable to this project.

3.4 FIRESTOPPING

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.

B. Maintain fire rating of penetrated fire barriers. Fire stop and seal penetrations made during construction.

1. Provide firestopping material for through and membrane penetrations of fire-rated barriers.

2. Install firestops in strict accordance with manufacturer's detailed installation procedures.

3. Install firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer's recommendations, local fire and building authorities, and applicable codes and standards referenced in PART 1 – REFERENCES. Apply of sealing material in a manner acceptable to the local fire and building authorities.

4. For demolition work, apply firestopping to open penetrations in fire rated barriers where cable is removed. Apply firestopping regardless of whether or not the penetrations are used for new cable or left empty after construction is complete.

5. Firestopping material used to seal open penetrations through which cable passes shall be re-usable/re-enterable.

List additional Firestopping product installation requirements above as applicable to this project.

3.5 EQUIPMENT RACKS/ENCLOSURES

See the DOC Telecommunications Distribution Design Guide for information on required drawing content, including telecommunications room Plan Views discussed below. Verify with DOC facility IT personnel whether vented shelves are to be provided for Owner installation.

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Provide EIA racks/cabinets and all associated hardware according to locations, elevations, and plan views as shown in the Contract Documents and furnish shelves directly to the Owner (not installed in the rack) for future Owner installation.

1. The CPI Standard Rack Model 55053-x03 is only permitted for use in Telecommunications Rooms.

2. The CPI Universal Rack Model 46353-x03 is permitted for use in both Telecommunications Rooms and Equipment Rooms.

B. For Floor Mount Racks/Cabinets:

1. Using ladder rack, horizontally affix the top of a given rack/cabinet to the wall as shown on the Contract Documents. Bolt horizontal ladder rack to rack/cabinet and to walls. Bolt rack/cabinet to floor.

C. Free Standing Equipment Racks: Provide six (6) cable support bars per rack to be used to provide additional cable support and routing control in the rear of the rack.

D. Free Standing Equipment Frames (Double Rails): Provide six (6) cable support bars per frame to be used to provide additional cable support and routing control in the rear of the frame.

E. Wall Mount Swing Gate Equipment Racks: Provide racks, sized and located as shown on the Contract Documents.

1. Provide Jumper rings/loops mounted at 8” intervals along each vertical rack rail.

2. Mount Wall-Mounted racks on unistrut rails in order to provide the 24” deep wall-mount rack with a minimum 26” depth.

3. Provide two (2) cable support bars per rack to be used to provide additional cable support and routing control in the rear of the rack.

F. Wall-Mount Rack Enclosures/Cabinets: Provide in sizes and locations as shown on the Contract Documents.

G. Hinged Wall-Mounted Brackets: Provide in sizes and locations as shown on the Contract Documents.

H. Flush Mounted Wall Brackets: Provide in sizes and locations as shown on the Contract Documents.

List additional Equipment Rack/Enclosure product installation requirements above as applicable to this project.

3.6 GROUNDING AND BONDING

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, and UL 467, ANSI/TIA/EIA standards and the references listed in PART 1 – REFERENCES above, as well as local codes which may specify additional grounding and/or bonding requirements.

Verify and edit referenced section titles.

1. Provide a minimum of one wall-mountable telecommunications ground bus bar per telecommunications room and as shown on the Contract Documents.

2. Grounding conductor shall be installed to bond all non-current carrying metal telecommunications equipment and materials to the nearest TMGB or TGB (as provided under Division 16 Section — "Grounding for Communications Circuits and Raceway").

   a. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic hardware.

   b. Provide ladder rack grounding kits to bond each section of ladder rack and bond ladder rack to racks/cabinets where ladder racks are connected.

List additional Grounding and Bonding product installation requirements above as applicable to this project.

3.7 PATCH PANELS

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Provide patch panels and horizontal wire management according to locations, elevations, and plan views as shown on the Contract Documents.

1. Copper: Size and install rack-mountable patch panels or the 110 VisiPatch System as shown on the Contract Documents. Use copper patch panels to terminate copper station cables. Install horizontal patch cable management supports below each patch panel.

   a. The 110 VisiPatch System shall not be used for data applications.

2. Fiber: Size and install rack-mountable patch panels as shown on the Contract Documents. Use fiber patch panels to terminate multimode and/or singlemode fiber backbone cables. Separate fiber patch panel rows shall be used to terminate different fiber optic cabling types (multimode versus singlemode). Install horizontal patch cable management supports below each patch panel.

Additional Patch Panel product installation requirements shall be added to the above list as applicable to this project.

3.8 CONNECTORS

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Copper Connectors (modular jacks):

1. For Horizontal Distribution:

   a. Provide connectors and install using T568B wiring pattern.

   b. Mount connectors at 90-degrees (i.e. straight, not angled)

Additional Connector product installation requirements shall be added to the above list as applicable to this project.

3.9 COPPER TERMINATION BLOCKS

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Provide termination blocks and (jumper troughs) with or without legs based on the following mounting conditions:

1. Mounting on Backboards: Provide termination blocks, jumper troughs, and distribution rings with legs and as shown on the Contract Documents. Use jumper troughs above and below each termination block in a column. Use a distribution ring backboard in place of jumper troughs in the vertical middle of each column of 600 pair or more.

2. Mounting on Racks: Provide termination blocks and jumper troughs without legs. Use rack mount brackets to mount termination blocks on EIA standard 19” floor and wall-mount racks.

B. Route cable horizontally along base of backboard until it reaches the termination block column on which it is to terminate and then route vertically to the termination block.

C. Punch down cable sequentially across the termination strips.

D. Punch down cable using only the selected SCS Manufacturer approved impact tool.

List additional Copper Termination Block product installation requirements above as applicable to this project.

3.10 STATIONS

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Faceplates: Shall provide a snug and sure fit for connectors – loose connectors are not acceptable.

1. Provide faceplates for stations in the locations and gang counts shown on the Contract Documents. In Secured Areas, provide Security Faceplates with associated mounting straps. Faceplates shall completely conceal outlet boxes, reducer plates, etc.

2. Unless otherwise noted in the Contract Documents, mount voice ports on top or left and mount data ports on bottom or right.

3. Flush-mount connectors on faceplates.

Coordinate with DOC facility personnel to determine the location of secured areas. Consider identifying these locations to the Contractors during the pre-bid walk through.

4. Provide Security Screws for faceplates.

List additional Station product installation requirements above as applicable to this project.

3.11 CABLE

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. General (applicable to all cable types): Provide non-plenum (CM/CMR, OFNR) rated cable for locations where cable is to be installed in conduit. For cable not installed in conduit, provide plenum (CMP,

OFNP) rated cable if cable is installed in a plenum air space environment, non-plenum rated otherwise. Cabling shall bear plenum or non-plenum markings for the environment in which it is installed.

1. For Horizontal Distribution: Provide station cable in types, sizes, and quantities as defined by the Symbol Schedule and as shown on the Contract Documents. Install cable between the station and its associated telecommunications room. Provide one cable per each connector at each station. Provide cables of the same type in the same color – multiple colors of the same cable type are not acceptable.

2. For Intrabuilding Backbone Distribution: Provide intrabuilding backbone cable in types, sizes, and quantities as shown on the Contract Documents. Install intrabuilding backbone cables between telecommunications rooms within the same building. Provide cables of the same type in the same color – multiple colors of the same cable type are not acceptable.

3. Install cable in compliance with ANSI/TIA/EIA and ISO/IEC 11801 requirements and BICSI TCIM practices.

4. Adhere to the bending radius and pull strength requirements as detailed in the ANSI/TIA/EIA standards and the manufacturer's installation recommendations during cable handling and installation.

    a. Pull all cables simultaneously where more than one cable is being installed in the same raceway.

    b. Use pulling compound or lubricant where necessary. Use compounds that will not damage conductor or insulation (Polywater, or approved equal).

    c. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway. Repair or replace conduit bushings that become damaged during cabling installation.

5. Install cable in a continuous (non-spliced) manner unless otherwise indicated.

6. Install exposed cable parallel to and perpendicular to surfaces on exposed structural members and follow surface contours where possible.

7. Tie or clamp cabling. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc. – with the exception of ceiling support anchors) is not acceptable. Install tie-wraps in conformance with the SCS manufacturer's installation recommendations. Do not over-tighten tie wraps or cause cross-sectional deformation of cabling.

8. Cable at the backboards:

    a. Lay and dress cables to allow other cables to enter raceway (conduit or otherwise) without difficulty at a later time by maintaining a working distance from these openings.

    b. Route cable as close as possible to the ceiling, floor, sides, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.

    c. Lay cables via the shortest route directly to the nearest edge of the backboard from mounted equipment or blocks. Support cables so as not to create a load on the equipment upon which the cables are terminated. Tie-wrap similarly routed and similar cables together and attach to D-rings vertically and/or horizontally, then route over a path that will offer minimum obstruction to future installations of equipment, backboards or other cables.

d. See COPPER TERMINATION BLOCKS above for details on routing copper cabling to termination blocks.

9. Cable in the telecommunications rooms:

a. For telecommunications rooms with ladder rack, lay cable neatly in ladder rack in even bundles and loosely secure cabling to the ladder rack at regular intervals with tie-wraps or velcro straps.

10. Cable terminating on patch panels located on racks:

a. Route cables in telecommunications rooms to patch panels on racks by routing across ladder rack across top of rack and then down vertical ladder rack to patch panel.

B. Copper Cable: Terminate all pairs within a cable. Un-terminated cable pairs are not acceptable.

1. For horizontal distribution: Provide station cable in the locations shown on the Contract Documents. Provide service loops with a minimum length of 12 inches in outlet boxes and long enough in the ER/TR's to reach termination equipment if moved to the farthest side of the room in the future, but no less than a minimum of 10 feet.

a. Provide Category 3 cable for inmate phone system stations only. Category 3 cable is not to be used for any other stations.

Exclude the following paragraph if OSP Rated CAT 5e/6 is not required on the project.

b. Install OSP Rated Category 5e/6 only in those locations shown on the Contract Documents.

c. Route station cable that is exposed (not in conduit) to comply with ANSI/TIA/EIA-569 rules for avoiding potential EMI sources and as follows:

Sources of Electromagnetic Interference	Telecommunications Infrastructure			
	Crossconnect Locations		Horizontal Cabling	
	Unshielded	Shielded	***Unshielded***	Shielded
Power Circuits Not in Metallic Raceway				
Less than 220 V_{rms}	2″	2″	2″	2″
Greater than 220 V_{rms} but less than 480 V_{rms}	10 ft	5 ft	5 ft	3 ft
Greater than 480 V_{rms}	20 ft	10 ft	10 ft	5 ft
Power Circuits in Metallic Raceway				
Less than 220 V_{rms}	2″	2″	2″	2″
Greater than 220 V_{rms} but less than 480 V_{rms}	5 ft	5 ft	3 ft	2 ft
Greater than 480 V_{rms}	10 ft	10 ft	5 ft	3 ft
Lightning Protection System Conductors	6 ft	6 ft	6 ft	6 ft
Ballasted Light Fixtures	1 ft	1 ft	1 ft	6″
Motors or Transformers				
Less than 220 V_{rms}	4 ft	2 ft	4 ft	1 ft
Greater than 220 V_{rms} but less than 480 V_{rms}	10 ft	5 ft	4 ft	2 ft
Greater than 480 V_{rms}	20 ft	15 ft	10 ft	5 ft
Metal Enclosed Electrical Panelboards, Motor Controls and Switchboards				
Less than 220 V_{rms}	4 ft	2 ft	2 ft	1 ft
Greater than 220 V_{rms} but less than 480 V_{rms}	10 ft	4 ft	4 ft	2 ft
Greater than 480 V_{rms}	20 ft	20 ft	10 ft	5 ft

2. For intrabuilding backbone distribution: Install intrabuiling backbone cable in the locations shown on the Contract Documents. Provide a service loop long enough in the TR's to reach termination equipment if moved to the farthest side of the room in the future, but no less than a minimum length of 10 feet at each end.

    a. Use unshielded, non-plenum multi-pair copper cable for connecting the back side of termination blocks to entrance protectors, telephone systems, and voice grade active electronics.

    b. For shielded cable, bond both ends of the metallic shield (or metallic strength) member to the nearest TGB (as furnished under Division 16 Section — "Grounding and Bonding for Telecommunications").

C. Fiber Cable: Terminate all fiber strands within a fiber cable. The installation of "dark fiber" is not acceptable.

1. For Intrabuilding Backbone Distribution:

    a. Test fiber optic cable on the reel upon delivery to the job site, and again prior to installation. Permanently affix the test results to the reel and submit a copy to the Owner prior to

installation. Do not install cables that fail the on-reel test. Replace any cables that fail the on-reel test at no additional expense to the Owner.

1) Test shall conform to the procedures as outlined in the paragraph entitled TESTING at the end of this specification section.

2) Demonstrate that the test results are in harmony with the factory test results as shipped with the reel.

b. For shielded cable, bond both ends of the metallic shield (or metallic strength) member to the nearest TGB (as furnished under Division 16 Section — "Grounding for Communications Circuits and Raceway").

c. Provide a service loop long enough in the ER/TR's to reach termination equipment if moved to the farthest side of the room in the future, but no less than a minimum of 10 feet at each end.

d. The service slack stored inside the fiber patch panel cabinets shall be a minimum of 3 m (10 ft).

List additional Cable product installation requirements above as applicable to this project.

3.12 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

Patch cables will generally be furnished by the Contractor and delivered to DOC IT personnel at the facility for installation. Include specific requirements for patch cables on the project, including quantity, color and length. DOC personnel shall determine lengths of patch cables and colors. Note that patch cable color for inmate LANs shall be green, no other patch cables shall be green in color.

A. Furnish copper patch cables for modular copper cross-connects. Deliver patch cables to Owner in the sizes, colors and quantities below:

1. Blue (for Administrative LAN):

a. Length (e.g. 3m) - (Qty)

b. Length (e.g. 1m) - (Qty)

2. Green (for Inmate LAN):

a. Length (e.g. 3m) - (Qty)

b. Length (e.g. 1m) - (Qty)

3. Red (for Radio-related):

a. Length (e.g. 3m) - (Qty)

b. Length (e.g. 1m) - (Qty)

B. Furnish fiber patch cables for fiber cross connects. Deliver patch cables to Owner in the lengths and quantities below:

1. Length (e.g. 3m) - (Qty)

2. Length (e.g. 1m) - (Qty)

C. Furnish one (1) spool of Category 3 jumper wire per telecommunications room for cross connects and deliver unopened to Owner.

D. Furnish velcro cable managers for managing patch cords in the telecommunications rooms. Provide in colors, sizes and quantities as indicated below. Cable managers shall be the same color as the patch cable type that they manage.

Include specific requirements for cable managers on the project, including quantity, color and size. Review and edit the information below as required for this project.

1. Furnish four (4) cable managers each 6 inches in length for each telecommunications room with fiber connectivity

2. Furnish one roll of 50 cable managers each 6 inches in length for use in Main Equipment Room.

List additional Patch Cable/Cross Connect requirements above as applicable to this project.

3.13 LABELING AND ADMINISTRATION

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. General: Labeling and administration shall comply with ANSI/TIA/EIA 606 and standard industry practices.

B. Color Coding: Apply industry standard color coding to cable termination fields. Always apply the same color at both ends of any given cable. Cross-connections are generally made between termination fields of different colors. The color may be applied to the backboard behind the termination equipment, may be the color of a cover on the termination equipment, or may be the actual color of the insert label on the termination equipment. Use the following color code:

1. Orange: Identification of the telecommunication service (telephone company) demarcation point.

2. Green: Identification of network connections on the customer side of the demarcation point.

3. White: Identification of first-level backbone in the building containing the main cross-connect, or may be used to identify the second-level backbone in buildings not containing the main cross-connect.

4. Gray: Identification of the second-level backbone in the building containing the main cross-connect.

5. Blue: Identification of the horizontal distribution (station) cables. A blue color coding is only required at the telecommunications room end of the cable, not at the station end of the cable.

6. Brown: Identification of inter-building backbone cables.

7. Yellow: Identification of inmate phone termination fields, auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.

8. Red: Identification of key telephone systems.

C. Telecommunications Rooms: In non-secured areas, affix a permanent label to the door of each telecommunications room. Where telecommunications room names are required in other labels, use the telecommunication room name shown on the Contract Documents. In secured areas, do not affix a label to telecommunications room doors.

D. Racks: Label racks as shown on the Contract Documents. Affix label centered across top cross-member of rack.

E. Grounding/Bonding Conductors: Label bonding conductors; “WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!”

F. Cables:

1. Label Location: Affix at each end of the cable.

2. Station Cables: Label station cables with the same label as the station connector (see STATION CONNECTORS (PORTS) below) that terminates the cable at the station location. Include a clear vinyl adhesive wrapping applied over the label in order to permanently affix the label to the cable. Using transparent tape to affix labels to cables is not acceptable.

3. Copper Backbone Cables: Label intrabuilding copper backbone cables in the form “M (TR to TR), ###-PR, CAT##, ###-FT ” where “M” stands for media type (“C” for “administrative copper” media or “I” for “inmate copper” media), “(TR to TR)” is the origination and destination telecommunications rooms between which the cable routes, “###-PR” is the pair count, “CAT##” is the cable type (i.e. CAT3 or CAT5E), and ###-FT is the cut length.

   a. Example: If a copper backbone cable running between telecommunications rooms “1A’ and “4A” were a 150-FT long, 100-PR, CAT3 cable used for inmate voice communications, then the label for the cable would read “I (1A to 4A), 100-PR, CAT3, 150-FT”

4. Fiber Backbone Cables: Label intrabuilding fiber backbone cables in the form “F (TR to TR), ###-ST, type, ###-FT ” where “F” stands fiber, “(TR to TR)” is the origination and destination telecommunications rooms between which the cable routes, “###-ST” is the strand count, “type” is the fiber type (i.e. SM, 62.5MM, etc), and ###-FT is the cut length.

   a. Example: If a 12-strand, 62.5/125µm fiber backbone cable running between telecommunications rooms “1A’ and “2A” were 75-FT long, then the label for the cable would read “F (1A to 2A), 12-ST, 62.5MM, 75-FT”

5. Provide labels at each end of each cable within 24” of telecommunications room entrance and again within 24” of termination point.

G. Termination Blocks:

1. General:

   a. Label termination block ports/pairs sequentially beginning on the first row of each termination block column. Begin with “001” for the first port/pair.

   b. Label termination strip pairs sequentially (left to right).

2. For Horizontal Distribution: Label termination blocks used for voice horizontal distribution with a single label affixed above the entire termination block column which reads “Voice Stations”. Label termination blocks used for inmate phone system horizontal distribution with a single label affixed above the entire termination block column that reads “Inmate Stations”.

3. For Backbone Distribution: Label termination blocks used for backbone distribution with a single label affixed above the entire termination block wall field which reads “Backbone”. Additionally, label each termination block column within the termination block wall field as follows:

   a. Label columns in the form “TR”, where “TR” is the telecommunications room where the backbone cable originates (see TELECOMMUNICATIONS ROOMS above). Use a new

column for each telecommunications room. Do not intermix cables from multiple telecommunications rooms in a single termination block column.

1) Example: If a termination block column on the fourth floor terminates backbone cabling from the first floor telecommunications room, then the column on the fourth floor would have the label "1A" and the termination block column on the first floor would have the label "4A."

H. Patch Panels:

1. For Horizontal Distribution:

a. General: Label patch panels as shown on the Contract Documents.

b. Ports: Ports are typically pre-labeled by the manufacturer with sequential numbers (i.e. 1 to 48). For ports which are not pre-labeled, label port in the form "##" where "##" is the sequential port number within the panel. Each patch panel shall start at port number "01".

1) For example: The ports on a patch panel terminating horizontal fiber optic cabling in duplex SC ports would be labeled starting with "01" for the first duplex port (one label per pair of fiber strands) and continue sequentially through the remainder of the duplex ports.

I. Station Connectors (Ports):

1. Connected to Patch Panels in the Telecommunications Room:

Refer to the Telecommunications Distribution Design Guide for information on the Port Designation labels shown on the Contract Documents.

a. Label connectors in the form "TR-PP#-##" where "TR" is the telecommunications room where the station cable terminates (see TELECOMMUNICATIONS ROOMS above), "PP#" is the patch panel identifier at which the station cable terminates (see, PATCH PANELS above) and "##" is the port number within the patch panel where the station cable terminates. Cross reference connector labels with the Port Designation label on the Contract Documents.

1) Example: If a faceplate has two copper cables terminated in the second telecommunications room on the fourth floor, in the third patch panel, in ports 5 and 6, then the connectors would have the labels "4B-PP3-05" and "4B-PP3-06" respectively.

2) Example: If a faceplate has a duplex fiber cable terminated in the first telecommunications room on the third floor, in the first patch panel, in port 4, then the connector would have the label "3A-PP1-04".

2. Connected to Termination Blocks in the Telecommunications Room:

Refer to the Telecommunications Distribution Design Guide for information on the Port Designation labels shown on the Contract Documents.

a. Label connectors in the form "TR-110-###" where "TR" is the telecommunications room identifier at which the station cable terminates (see TELECOMMUNICATIONS ROOMS above), "110" represents the 110 termination block, and "###" is the sequential termination block port number, within a given termination block column, where the station cable terminates. Cross reference connector labels with the Port Designation label on the Contract Documents.

1) Example: If a faceplate has two copper cables terminated in the second telecommunications room on the fourth floor on termination block ports 5 and 6, then the connectors would be labeled “4B-110-005” and “4B-110-006” respectively.

J. Conduits: Label each conduit end (existing or new) in a clear manner by designating the location of the other end of the conduit (i.e. room name, telecommunications room identifier, pull box identifier, outlet identifier (use the label of the first port of the outlet as the outlet identifier), etc.). Indicate conduit length on the label.

K. Pull Strings: Label each pull string in a clear manner by designating the location of the other end of the pull string (i.e. room name, telecommunications room name, pull box identifier, outlet identifier (use the label of the first port of the outlet as the outlet identifier), etc.).

List additional Labeling requirements above as applicable to this project.

3.14 TESTING

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Provide test records on a form approved by the Owner and Engineer/Designer. Include the test results for each cable in the system. Submit the test results for each cable tested with identification as discussed under LABELING AND ADMINISTRATION above. Include the cable identifier, outcome of test, indication of errors found, cable length, retest results, and name and signature of technician completing the tests. Provide test results to the Owner and Engineer/Designer for review and acceptance within two weeks of Substantial Completion.

1. Print test records for each cable within the system directly from the tester and submit in paper form (in a binder) and in electronic form (on diskette or CDROM) to the Owner and Engineer/Designer for review. Handwritten test results will not be accepted.

B. Test the SCS after installation for compliance to all applicable standards as follows:

1. Copper:

a. For Horizontal Distribution: Test all pairs of each copper station cable, for conformance to ANSI/TIA/EIA 568-B Category 6 (draft), and ANSI/TIA/EIA 568-B standards. To the extent possible, perform tests with building electrical systems fully powered on (i.e. Lights, HVAC, etc.).

1) Test each end-to-end link (the entire channel from the connector at the station to the connector or termination in the telecommunications room) utilizing sweep tests, for continuity, shorts, polarity, near-end cross talk (NEXT), far-end cross talk (FEXT), attenuation, installed length, transposition (wire map), mutual capacitance, characteristic impedance, resistance, ACR, and presence of AC voltage. Use the Power Sum method to test NEXT and FEXT. Test each cable in both directions.

2) Use a TIA/EIA Level III testing instrument, re-calibrated within the manufacturer’s recommended calibration period, with the most current software revision based upon the most current ANSI/TIA/EIA testing guidelines, capable of storing and printing test records for each cable within the system and equipped with the current "Lucent/Avaya Gigaspeed test adapters".

a) Testing Device: Fluke DSP-4000 with latest software and hardware releases for Avaya GigaSpeed CAT-6 horizontal distribution cables, or approved equal.

3) In addition to the above, perform tests both recommended and mandated by Avaya. Tests shall confirm/guarantee compliance to Avaya Ethernet GigaSPEED 1000B-T

(1000 Mb/s IEEE 802.3ab) and 1000B-TX (1000 Mb/s ANSI/TIA/EIA-854) applications based on the data contained in the Avaya Performance Specifications, Volume 1, May 2001 or latest edition.

b. For Intrabuilding Backbone Distribution: Test all cable pairs for length, shorts, opens, continuity, polarity reversals, transposition (wire map), and the presence of AC voltage. All pairs shall demonstrate compliance to TIA/EIA 568-B Category 3 standards.

1) Test copper cable on the reel upon delivery to the job site, again prior to installation, and again after installation.

2) Test entire channel, from termination block to termination block.

3) Use a TIA/EIA Level III testing instrument, re-calibrated within the manufacturer's recommended calibration period, with the most current software revision based upon the most current TIA/EIA testing guidelines, capable of storing and printing test records for each cable within the system.

a) Fluke DSP-4000, or approved equal.

2. Fiber: Test fiber optic cable on the reel upon delivery to the job site prior to installation, and again after installation.

a. Prior to testing, calculate the cable loss budget for each fiber optic cable and clearly show the result on the test documentation. Calculate maximum loss using the following formula, assuming no splices:

1) For Horizontal Distribution:

a) Max Loss = 2.0db (per ANSI/TIA/EIA 568-B)

2) For Backbone Distribution:

a) Max Loss = [(allowable loss/km) * (km of fiber)] + [(.3db) * (# of connectors)]

b) A mated connector to connector interface is defined as a single connector for the purposes of the above formula.

c) A given fiber strand shall not exceed its calculated maximum loss (per the above formula).

b. Test all strands using a bi-directional end-to-end optical transmission loss test instrument (such as an OTDR) trace performed per ANSI/TIA/EIA 455-61 or a bi-directional end-to-end power meter test performed per ANSI/TIA/EIA 455-53A, and ANSI/TIA/EIA 568-B, and the Avaya Communication SCS Field Testing Guidelines (latest edition).

1) Calculate loss numbers by taking the sum of the two bi-directional measurements and dividing that sum by two.

2) Provide test measurements as follows:

a) For Multimode Cable: Test at both 850 and 1300nm.

b) For Singlemode Cable: Test at both 1310 and 1550nm.

c. Test results shall conform to:

1) The criteria specified in ANSI/TIA/EIA-568B

2) The Contractor's calculated loss budget above

3) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)

a) In addition to the above, perform tests both recommended and mandated by Avaya. Tests shall confirm/guarantee compliance to Avaya Ethernet GigaSPEED 1000B-X performance, and IEEE 802.3z for a maximum end-to-end dB loss of 2.5 dB.

4) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)

C. Identify cables and equipment that do not pass to the Owner and Engineer/Designer. Determine the source of the non-compliance and replace or correct the cable or the connection materials, and retest the cable or connection materials at no additional expense to the Owner. Provide new test results to the Owner and Engineer/Designer in the same manner as above.

1. In addition to the above, if it is determined that the cable is at fault, remove the damaged cable and replace it with a new cable. Cable "repairs" are not acceptable. The procedure for removing the cable shall be as follows:

a. Prior to removal of damaged cable and installation of new cable:

1) Inform the Owner and Engineer/Designer of the schedule for the removal and installation.

2) Test the new cable on the reel per paragraph B, above.

3) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.

4) Provide test results to the Owner and Engineer/Designer for approval by the Owner and Engineer/Designer.

b. Remove the damaged cable and provide new cable.

c. After the removal of the damaged cable and installation of the new cable:

1) Test the new cable per the paragraph titled TESTING.

2) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether they are new cables installed as part of this project or existing cables installed prior to this project.

a) If any of the cables requiring testing are in use, coordinate with the Owner to schedule an outage opportunity during which the testing can be performed.

3) Provide test results to the Owner and Engineer/Designer for approval by the Owner and Engineer/Designer.

d. If a cable which occupies the same innerduct or conduit (if not in innerduct) as a damaged cable is damaged by the extraction and installation process, replace the cable at no additional expense to the Owner.

1) Damaged cables which are replaced shall be subject to the testing procedures of the paragraph titled TESTING.

List additional Testing requirements above as applicable to this project.

3.15 FOLLOW UP

Review any contractor follow-up requirements with the DOC project manager and clearly state these requirements in the following paragraph(s).

A. For the first four weeks that the system is in full operation, provide technical assistance for trouble shooting, training, and problem solving by phone and (within 24 hours of notice) on site. Provide up to 40 hours of assistance (in addition to any warranty-related work), including phone, travel, and on site time during this period.

END OF SECTION

SECTION 16741 – OUTSIDE PLANT COMMUNICATIONS CIRCUITS

SECTION 16741 — OUTSIDE PLANT COMMUNICATIONS CIRCUITS

1 PART 1 - GENERAL

PART 1 - GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State Department of Corrections telecommunications projects. This information is provided in specification format to serve as a guide to the Engineer/Designer in producing a CSI-compliant specification that will meet the unique requirements of DOC Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Engineer/Designer may edit this section (adding and/or removing content where required), but shall not create a new specification section based on the “intent” of the TCGS, or cut and paste content from the TCGS sections into other existing specification sections..

Text in shaded boxes (such as this text) is included to aid the Engineer/Designer in understanding areas of this Guide Specification that may require modification for a particular project. Although this text is generally written in declarative form, the Engineer/Designer shall consider it guidance only. The Engineer/Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

1.1 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this Section.

1.2 SUMMARY

Review and edit the following list of generic type products and work for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

A. Provide all materials and labor for the installation of a customer-owned outside plant telecommunication system. This section includes Customer-Owned Outside Plant Communications cabling, termination, and administration equipment and installation requirements for the specified Outside Plant Structured Cabling System (OSP-SCS - See Definition Below).

B. Related sections include but are not necessarily limited to the following:

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the contractor’s responsibility for coordinating work.

1. Division 16 Section — "Basic Electrical Materials and Methods"
2. Division 16 Section — "Outside Plant Communications Site Work"
3. Division 16 Section — "Raceway and Boxes for Communications Circuits"
4. Division 16 Section — "Grounding and Bonding for Telecommunications"

5. Division 16 Section — "Inside Plant Communications Circuits"

C. Products furnished (but not installed) under this section:

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. When installations are “By Owner” consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner- Installed Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

D. Products installed (but not furnished) under this section -

Include this paragraph only if products will be installed under this section but furnished under other sections or by the Owner. For example, DOC may pre-purchase fiber, but have the Contractor install. When products are furnished “By Owner” consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner-Furnished Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

Consider including paint for backboards, grounding conductors, and any other items that are installed under this section but not furnished under this section.

1. Grounding Conductor

2. Firestopping

E. Provide Unit Prices for:

Include this paragraph only if unit pricing will be required for a specific part of the project. Include statements on how to measure the quantity. For example, unit prices may be requested for cable, patch panels, etc. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Engineer/Designer shall verify with the DOC PM and/or the DOC IT Specialist assigned to the project whether the latest edition and/or addenda of each required reference is appropriate and specify the edition and addenda below accordingly.

A. Incorporate by reference the applicable portions of the following specifications, standards, codes into this specification section.

1. General:

a. National Electrical Code (NEC)

b. National Electrical Safety Code (NESC)

c. Washington Industrial Safety and Health Act (WISHA)

d. Occupational Safety and Health Act (OSHA)

2. Communications:

a. ANSI/TIA/EIA - 455: *Fiber Optic Test Standards*

b. ANSI/TIA/EIA - 526: *Optical Fiber Systems Test Procedures*

c. ANSI/TIA/EIA - 568-B: *Commercial Building Telecommunications Cabling Standard*

d. ANSI/TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*

e. ANSI/TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*

f. ANSI/TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*

g. ANSI/TIA/EIA - 758: *Customer-Owned Outside Plant Telecommunications Cabling Standard*

h. IEEE 802.3 (series): *Local Area Network Ethernet Standard,* including the IEEE 802.3z *Gigabit Ethernet Standard*

i. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*

j. BICSI*: BICSI Telecommunications Cabling Installation Manual*

k. BICSI*: BICSI Telecommunications Distribution Methods Manual (TDMM)*

l. BICSI*: BICSI Customer-Owned Outside Plant Design Manual*

1.4 DEFINITIONS

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Engineer/Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - "Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations".

Install - "Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations".

Provide - "To furnish and install, complete and ready for the intended operation".

A. "OSP-SCS" shall mean *Outside Plant - Structured Cabling System*. The OSP-SCS is defined as all required equipment and materials including, but not limited to, ANSI/TIA/EIA and ISO/IEC compliant copper and fiber optic cable (multimode and singlemode), connectors, splices, splice enclosures and other incidental and miscellaneous equipment and materials as required for a fully operational, tested, certified, and warranted system, compliant with all applicable codes and standards.

B. "MH" shall mean *Maintenance Holes* or *Handholes* used for the routing of communications cables.

C. "TMGB" shall mean *Telecommunications Main Grounding Busbar.* There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.

D. "TGB" shall mean *Telecommunications Grounding Busbar.* There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.

E. "TBB" shall mean *Telecommunications Bonding Backbone.* The TBB is a conductor used to connect TMGBs to TGBs.

1.5 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA and ISO/IEC compliant communications Outside Plant Structured Cabling System (OSP-SCS) as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating voice, data, and video signals onto a common media, and shall be tested for and be capable of Gigabit Ethernet operation as specified in IEEE 802.3z.

B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant OSP-SCS.

1.6 SUBMITTAL INFORMATION

Review and edit the following list of submittals as applicable to this project. Note that the submittals listed below are specific to this section only. Division 1, Section 01300 (or equivalent) – Submittals should include general administrative requirements (e.g. schedule, number of copies, distribution, etc.). Either Section 01300 or this section should include a statement similar to the following, "The Contractor shall apply Contractor's stamp, sign, or initial certifying that review, verification of required Products, and coordination of information is in accordance with the requirements of the work and Contract Documents.

Any deviations from the Contract Documents or specified product data shall be clearly noted, and must be approved by the Engineer/Designer prior to start of construction. The Engineer/Designer shall obtain approval from DOC through the Alternative Design Request (ADR) process prior to approving a Contractor-submitted deviation.

If the deviation is not approved by the Engineer/Designer it remains the Contractor's responsibility to provide what is required in the Contract Documents".

A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.

1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.

2. For those items noted as allowing "or equal," and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.

3. Provide standard manufacturer's cut sheets and the operating and maintenance (O&M) instructions at the time of submittal review for each device in the system, regardless of whether it is submitted as specified or as an approved equal. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive the materials.

B. Quality Assurance/Control Submittals: Provide submittal information for review as follows:

1. Submit a cable routing and grouping plan as follows:

   a. Where the cable routing and grouping is to be provided as shown on the Contract Documents, do not provide a cable routing and grouping plan. Submit written documentation stating that the cable routing and grouping will be provided as shown on the Contract Documents, that the Contractor has reviewed the routing and grouping on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts between trades, and that the routing and grouping meets applicable codes, regulations and standards.

   b. Where changes in cable routing and grouping are proposed, submit complete floor plan(s) and/or detail drawing(s) showing the proposed routing, raceway sizes and locations, and cabling in a manner equal to that of the Contract Documents. Ensure that any cabling changes are coordinated with comparable accommodating changes to the raceway routing and grouping. Specifically note each location where the proposed routing and grouping is different from the Contract Documents. Submit written documentation detailing the reason for each change request. Each change request must be approved in writing by the Engineer/Designer prior to proceeding with the change.

2. Submit wall field termination block and wire management elevations as follows:

   a. Where wall field termination blocks and wire management are to be provided as shown on the Contract Documents, do not submit elevations. Submit written documentation stating that the wall field termination blocks and wire management will be provided as shown on the Contract Documents, that the Contractor has reviewed the elevations on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts between trades, and that the elevations meet applicable codes, regulations and standards.

   b. Where changes to the wall field termination blocks and wire management are proposed, or where elevations have not been included on the Contract Documents, submit wall field termination block and wire management elevations along with written documentation detailing the reason for the change. The change request must be approved in writing by the Engineer/Designer prior to proceeding with the change.

3. Submit a list of proposed test equipment for use in verifying the installation of the SCS. Proposed test equipment shall meet the criteria as stated in PART 3 – TESTING.

   a. Submit for each testing device:

      1) Manufacturer and product number.

      2) Documentation from the manufacturer showing date and outcome of last re-calibration. Testing device shall have been re-calibrated within the manufacturer's recommended calibration period, encompassing the period of time when the testing device will be used on this project.

      3) Documentation from the manufacturer showing software revision. Software revision shall be most current revision available for the device and shall be based upon the most current ANSI/TIA/EIA testing guidelines.

   b. Submit proposed copper and fiber cable test forms (see PART 3 – TESTING for more detail).

4. Submit a list of the personnel who will be assigned to the project, the type of work they will be performing per QUALITY ASSURANCE below, and copies of the manufacturer's training

certification for each. If personnel changes are made during the project, submit the above information for any new personnel prior to them beginning work on the project.

C. Closeout Submittals: Provide submittal information for review as follows:

A telecommunications-specific Operations and Maintenance (O&M) Manual for Communications shall be required for each project. O&M information submitted under other related communications sections (e.g. Raceway and Boxes for Communications Circuits, Bonding and Grounding for Communications, etc.) shall be included in the O&M Manual and statements should be included in each section directing the Contractor to provide applicable information in the O&M Manual for Communications. The requirement that the Contractor provide an O&M Manual for Communications should be stated in this section or in Inside Plant Communications Circuits.

1. O&M Manual for Communications - At the completion of the project, submit O&M information from product data submittals (above), updated to reflect any changes during the course of construction, to the Engineer/Designer in the telecommunications-specific O&M Manual for Communications binder labeled with the project name and description.

2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.

b. Keep Record Drawings at the job site and make available to the Owner and Engineer/Designer at any time.

c. Keep Record Drawings current throughout the course of construction. (“Current” is defined as not more than one week behind actual construction).

d. Show identifiers for major infrastructure components on Record Drawings.

Refer to the DOC Telecommunications Distribution Design Guide for format and content of the cable records described below.

e. Provide a table/schedule showing the following information for each cable link in the project on the Record Drawings. Base the table/schedule on the schedule provided by the Engineer/Designer in the Project Manual. Items 1 through 6 and item 8 have already been completed by the Engineer/Designer and are included in the table/schedule. Complete items 7 and 9. Include the following items in the table/schedule:

1) End locations of cable (telecommunications room)

2) Link Type (campus, riser, horizontal)

3) Media type (fiber, Cat 5, Cat 3, etc.)

4) Proposed usage (voice, data, lighting control, etc.

5) Cable Identifier

6) As-designed maximum link length

7) Actual measured link length (from test results)

8) For fiber optic cabling, as-designed maximum link attenuation at design frequency (indicating frequency used for design calculations) including as-designed maximum splice loss and as-designed maximum connector loss

9) For fiber optic cabling, actual measured link attenuation as tested with test frequency (from test results)

10) For copper cabling, actual measured headroom (from test results)

1.7 QUALITY ASSURANCE

The following are DOC requirements for Telecommunications Contractors and Telecommunications Contractor Employees. Review these requirements with the DOC IT Infrastructure Specialist and include as applicable to this project.

For projects that are not being quoted by Contractors on the WA State DIS Master Contract list, consider establishing a deadline prior to the bid date for Contractors to have submitted prequalification documentation demonstrating that they meet the qualification requirements. Also, consider publishing the list of prequalified Contractors as an addendum prior to the bid deadline.

A. Contractor Qualifications: Prior to bidding the project, submit:

1. Documentation from the OSP-SCS manufacturer demonstrating that the Contractor is trained and certified by the Manufacturer to install, test, and maintain the SCS and is certified by the OSP-SCS Manufacturer to provide the OSP-SCS Manufacturer's Warranty (see PART 1 - WARRANTY).

   a. Avaya Communication: SYSTIMAX SCS Installation Contractor (for copper and fiber).

2. Documentation indicating that the Contractor will have only manufacturer-trained and manufacturer-certified employees perform installation, testing, and firestopping work, as detailed below.

3. Documentation demonstrating that the Contractor employs a minimum of one Registered Communications Distribution Designer (RCDD) certified by and in current good standing with BICSI. The RCDD shall be a direct full time employee of the Contractor (i.e. an RCDD consultant/sub-contractor to the Contractor is not acceptable). The document shall also declare that the Contractor will continue to employ a minimum of one RCDD throughout the duration of the project.

4. List of references for no less than five similar projects (in terms of size and construction cost) performed by the Contractor under the Contractor's current business name within the past three years. Detail the following for each project:

   a. Project name and location

   b. Construction cost

   c. A brief description of the project, the components involved, and the OSP-SCS manufacturer used on the project.

   d. Number of station drops

   e. Customer contact names, phone numbers, and addresses

Include the following paragraph (or one similar) only if the project is to be constructed under the State of Washington Department of Information Services (DIS) Master Contract. Use of the DIS contract shall be discussed with the DOC project manager prior to the completion of Design Development. Pre-qualified Contractors from the DIS list shall be recommended by the Engineer/Designer and approved by the DOC project manager. Review and edit the section numbers and titles below and coordinate content as applicable to this project.

5. Documentation demonstrating that the Contractor has a current Master Contract with the State of Washington Department of Information Services (DIS) per the requirements in Section 01010, and shall be on the DOC pre-qualified DIS contractor list shown in Section 01010.

B. Contractor's employees directly involved with the supervision, installation, testing, and certification of the SCS shall be trained and certified by the selected SCS' manufacturer. Training and certifications by employee type are required as shown below:

1. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation and testing.

2. Test Technicians: All (100%) shall be trained/certified for installation and testing.

3. Installation Technicians: All (100%) shall be trained/certified for installation.

4. Other personnel: Personnel not directly responsible for installation supervision, installation, testing or certifying the SCS (i.e. project managers, cleanup crew, etc.) are not required to be manufacturer trained and certified.

C. Contractor's employees whose duties include the application of firestopping material shall be trained and certified by the specified firestopping manufacturer. Training and certifications by employee type are required as shown below:

1. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation.

2. Firestopping Technician: All (100%) shall be trained/certified for installation.

1.8 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing.

A. Provide coordination with Avaya Communication to ensure that Avaya Communication inspectors are available to schedule site visits, inspections, and certification of the system. Provide and coordinate any Avaya Communication-required modifications and have Avaya Communication re-inspect and certify the system prior to the scheduled use of the system by the Owner.

B. The Contractor is solely responsible for all costs associated with scheduling the Avaya Communication inspection, the inspection itself and any Avaya Communication required re-inspections, and for any modifications to the installation as required by Avaya Communication.

1.9 WARRANTY

Coordinate this paragraph with the conditions of the contract and Division 1 requirements to ensure that no statements are made that will limit or void those conditions. The Engineer/Designer is required to have a thorough understanding of the manufacturer warranties applicable on this project. The Engineer/Designer shall consider, account for, and advise DOC regarding any unique warranty situations that may arise from Owner-furnished equipment, Owner-installed equipment, or other situations that may conflict with warranty requirements.

A. Contractor Warranty:

1. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.

    a. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.

        1) The Contractor Warranty period shall commence upon Owner acceptance of the work.

B. OSP-SCS Manufacturer Warranty:

1. Provide a OSP-SCS Manufacturer extended product, performance, application, and labor warranty that shall warrant all passive components used in the OSP-SCS. Additionally, this warranty shall cover components not manufactured by the OSP-SCS Manufacturer, but approved by the OSP-SCS Manufacturer for use in the OSP-SCS (i.e. “Approved Alternative Products”). The OSP-SCS Manufacturer warranty shall warrant:

    a. That the products will be free from manufacturing defects in materials and workmanship.

    b. That the cabling products of the installed system shall exceed the specification of ANSI/TIA/EIA 568-B and exceed ISO/IEC 11801 standards.

    c. That the installation shall exceed the specification of ANSI/TIA/EIA 568-B and exceed ISO/IEC 11801 standards.

    d. That the system shall be application independent and shall support both current and future applications that use the ANSI/TIA/EIA 568-B and ISO/IEC 11801 component and link/channel specifications for cabling.

2. Provide materials and labor attributable to the fulfillment of this warranty at no cost to the Owner.

3. The OSP-SCS Manufacturer Warranty shall be provided by the selected OSP-SCS Manufacturer and shall be:

    a. Avaya Communication SYSTIMAX Structured Connectivity Solution Extended Product Warranty and Application Assurance Program (20 Years).

        1) Provide a copy of the SYSTIMAX Registration Document to the Owner at the time of submittal to Avaya.

4. The OSP-SCS Manufacturer Warranty period shall commence upon a Warranty Certificate being issued by the manufacturer. The Warranty Certificate shall be issued no later than three months after Owner acceptance of the work.

2 PART 2 - PRODUCTS

PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

DOC has standardized on Avaya Communication for all new Structured Cabling Systems in DOC facilities. Products shall be specified accordingly. The Engineer/Designer shall ensure that the latest Avaya part numbers are used for specified products. “Or-Equal” substitutions for Avaya products are not permitted.

Some of the following paragraphs include ancillary products manufactured by companies other than Avaya Communication, but do not indicate that they allow "or equal" substitutions. If the Engineer/Designer wishes to use other products in lieu of non-AVAYA ancillary products, an alternative product request shall be submitted in writing to the DOC IT Infrastructure Specialist. This request shall follow the format and procedures of the Alternative Design Request identified in the TDDG, and include detailed literature from the manufacturer of the alternative product. If the alternative product is approved, the Engineer/Designer shall ensure that the specification is written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by their design are specified with equal or greater detail to the following paragraphs. The Engineer/Designer shall also verify that the most current part number of each specified product is listed in this section.

2.1 GENERAL

A. Unless specifically stated as "Or equal", equivalent items are not acceptable, provide items as specified.

B. Physically verify existing site conditions prior to purchase and delivery of the materials, including but not limited to lengths and condition of conduit and/or pathway (including maintenance holes and handholes) to be used for routing backbone cabling. Pre-cut materials of insufficient length are the sole responsibility of the Contractor.

C. OSP-SCS components shall be manufactured by a single manufacturer. Components shall not be intermixed between different manufacturers unless the manufacturer of the OSP-SCS has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the OSP-SCS Manufacturer Warranty (see PART 1 - WARRANTY).

D. Bid only one OSP-SCS Manufacturer and only bid a manufacturer for which the Contractor is certified. The OSP-SCS Manufacturer shall be the following. Substitution is not acceptable:

1. Avaya Communication

E. For a given manufacturer, all components shall be part of a single OSP-SCS product line – components shall not be intermixed between a manufacturer's OSP-SCS product lines. The OSP-SCS product line shall be engineered "end-to-end" – the system and all of it's components shall be engineered to function together as a single, continuous transmission path.

1. The OSP-SCS Product Line shall be the following, per manufacturer. Substitution is not acceptable:

a. For Avaya: SYSTIMAX

F. Provide all incidental and/or miscellaneous hardware not explicitly specified or shown on the Contract Documents that is required for a fully operational, tested, certified and warranted system.

2.2 RACEWAY

Review and edit the following products/part numbers as applicable to this project. If section numbers and titles are referenced, verify for accuracy.

A. As specified under Division 16 Section – "Outside Plant Communications Site Work", Division 16 Section – "Raceway and Boxes for Communications Circuits" and Division 16 Section – "Inside Plant Communications Circuits" except where noted below.

1. Innerduct:

   a. Outside Plant: Corrugated, bright orange, and rated for outdoor duct installation.

      1) 1” Diameter

      2) 1-1/4” Diameter

   b. Intrabuilding: Corrugated, bright orange, and rated for indoor installation.

      1) 1” Diameter - non-plenum rated

      2) 1-1/4” Diameter - non-plenum rated

      3) 1” Diameter - plenum rated

      4) 1-1/4” Diameter - plenum rated

2.3 FIRESTOPPING

Review and edit the following products/part numbers as applicable to this project. If section numbers and titles are referenced below, verify for accuracy.

A. As specified in Division 16 Section – “Inside Plant Communications Circuits.”

2.4 EQUIPMENT RACKS/ENCLOSURES

Review and edit the following products/part numbers asapplicable to this project. If section numbers and titles are referenced below, verify for accuracy.

A. As specified in Division 16 Section – “Inside Plant Communications Circuits.”

2.5 TERMINATION EQUIPMENT

Review and edit the following products/part numbers as applicable to this project. If section numbers and titles are referenced below, verify for accuracy.

A. Voice Backbone Copper Building Entrance Protectors (BEPs). Complete with lockable covers and plug-in protector modules for each pair terminated on the chassis. Protector modules shall provide over-voltage and sneak current protection. BEPs and protectors shall be manufactured by the selected OSP-SCS Manufacturer:

   1. For Avaya:

      a. Protectors: 489A Building Entrance Protector

         1) Mounting brackets: Avaya 249A Mounting Bracket

         2) Protector units/modules: 4B-EW Series

         3) Associated lock wrench

DOC does not generally allow the use of OSP rated cable in the horizontal data environment. If a design solution (approved by DOC) requires the use of OSP rated Category 5e/6, then include the following paragraph. (Note that Avaya presently makes only a CAT-5 rated OSP cable). An alternative DOC-approved OSP CAT-5e/6 cable should be specified. OSP-rated Category 5e/6 cabling for this application is specified in the Inside Plant Communications Circuits section.

B. OSP Copper Data Station Entrance Protectors. Protectors shall be manufactured by the selected OSP-SCS Manufacturer:

1. For Avaya:

    a. Protectors: Category 5 OSP Protector (or approved CAT-5e/6 alternative)

2.6 CABLE

Verify whether Outdoor or Indoor/Outdoor cable will be required for the project. Consult the DOC Project Manager as well as maintain compliance with the NEC 50-ft rule.

A. Outdoor Cable: Rated for outdoor use, duct installation, and/or direct burial installation as dictated by the application.

1. Fiber Optic Cable: All-dielectric, meeting or exceeding ANSI/TIA/EIA and industry standards including Bellcore GR-20-CORE specifications. Cables and fan-out kits shall be manufactured by the selected OSP-SCS Manufacturer:

    a. Multimode: All-dielectric, multimode graded index, 62.5/125 multimode, with a maximum attenuation of 3.5 dB/km at 850 nm and 1.0 dB/km at 1300 nm and bandwidth of 200 MHz/km at 850 nm and 500 MHz/km at 1300 nm.

        1) For Avaya:

            a) Outdoor rated: Avaya 3DNX/Nonmetallic LXE

            b) Indoor/Outdoor rated: Avaya/Lucent/Fitel Option 1

    b. Singlemode: All-dielectric with a maximum attenuation of 0.4 dB/km at 1300 nm and 0.3 dB/km at 1550 nm.

        1) For Avaya:

            a) Outdoor rated: Avaya 4DNX/Nonmetallic LXE

            b) Indoor/Outdoor rated: Avaya/Lucent/Fitel Option 1

    c. Hybrid/Composite: Conform to the Multimode and singlemode characteristics above.

        1) For Avaya:

            a) Outdoor rated: Avaya NCA/Nonmetallic LXE

            b) Indoor/Outdoor rated: Avaya/Lucent/Fitel Option 1

2. Copper Cable:

    a. For Backbone: Shielded, with 24-AWG solid copper conductors insulated with color coded PVC. UL Verified to ANSI/TIA/EIA 568-B for Category 3 performance. Insulated with filled foam skin-DEPIC and conform to RUS 7 CFR 1755.890 (REA PE-89). Cable shall be manufactured by or listed as an “approved alternative product” by the selected OSP-SCS Manufacturer:

        1) For Avaya: Avaya ASP-Filled ANMW Category 3 Core Cable

    b. For Termination Block Connections (back-side): Unshielded, non-plenum multi-pair copper cable, 24-AWG, solid copper conductor, insulated with color coded PVC. UL Verified to ANSI/TIA/EIA 568-B for Category 3 performance. Cable shall be manufactured by the selected OSP-SCS Manufacturer:

        1) For Avaya: Category 3, 1010

2.7 LABELING AND ADMINISTRATION

Review and edit the following products/part numbers as applicable to this project.

A. Labels

1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, typed, and created by a hand-carried label maker or an approved equivalent software-based label making system. Handwritten labels are not acceptable.

a. Inside Telecommunication Rooms:

1) Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

b. Outside Plant: Waterproof

1) Panduit Marker Tie (or approved equal)

2. Hand-carried label maker:

a. Brady: ID Pro Plus (or approved equal).

3 PART 3 - EXECUTION

PART 3 - EXECUTION

3.1 GENERAL

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

DOC has standardized on Avaya Communication for all new Structured Cabling Systems in DOC facilities. Installation requirements shall be specified accordingly.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Engineer/Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by their design are specified in Part 2 with corresponding installation requirements specified in Part 3.

A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.

B. All work shall comply with applicable safety rules and regulations including OSHA and WISHA. All work shall comply with the requirements of the National Electrical Safety Code (NESC) and the NEC except where local codes and/or regulations are more stringent, in which case the local codes and/or regulations shall govern.

C. All work shall comply with the standards, references and codes listed in PART 1 -- REFERENCES above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.

D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.

E. Replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.

F. Store all materials so as to be protected from the elements. Pathway materials (conduit, fittings, maintenance holes, etc.) are permitted to be stored outdoors if stacked on boards to avoid direct contact with the ground. The Contractor shall be responsible for any deteriorating effects on the materials due to improper storage (or outdoor storage) prior to installation including damage caused by prevailing weather conditions.

G. Remove surplus material and debris from the job site and dispose of legally.

3.2 DEMOLITION

The Engineer/Designer shall coordinate with local DOC authorities to determine whether DOC wishes to retain certain demolished material or wishes to have it hauled away. Review any demolition requirements for this project with the DOC project manager and edit the following paragraph or create a similar paragraph as applicable.

A. Demolish existing telecommunications equipment, cable, materials, and incidentals no longer in use after installation of the new OSP-SCS.

1. Mandrel, clean, and cap outside plant conduits left empty after demolition of outside plant cables.

a. Clean each conduit with a wire brush, swab, and prove out with a minimum 16 inch long test mandrel that is ¼ inch smaller than the inside diameter of the duct. Clean conduit a minimum of two times in the same direction. Swab with clean rags until the rag comes out of the conduit clean and dry. Swab away from buildings for duct sections connected to buildings.

2. Properly and legally dispose of demolished materials.

B. Coordinate the demolition schedule with the Owner. Do not proceed with demolition prior to approval from the Owner.

3.3 RACEWAY

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Provide and install as specified under Division 16 Section – “Outside Plant Communications Site Work”, Division 16 Section – Raceway and Boxes for Communications Circuits and Division 16 Section – “Inside Plant Communications Circuits” except where noted below:

B. Outside Plant Innerduct:

1. Provide in quantities and sizes as required and as shown on the Contract Documents.

2. Provide sufficient innerduct slack to allow for innerduct shrinkage after stretching during installation.

3. Avoid excessive pulling tension. Replace corrugated innerduct showing evidence of excessive pulling tension at no cost to the Owner.

4. Rack and secure innerduct inside maintenance holes and handholes. If existing maintenance holes and handholes have insufficient racking to support new cabling, provide racking.

5. Cap innerduct immediately after placement in order to prevent debris from entering. Uncap only when cable is to be installed.

C. Inside Plant Innerduct

1. Provide innerduct for outside plant fiber optic cables from termination points within buildings to outside conduit entrances and in the sizes and locations shown on the Contract Documents. Provide plenum-rated innerduct within plenum rated spaces.

List additional Raceway product installation requirements above as applicable to this project.

3.4 FIRESTOPPING

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate.

A. Provide as specified in Division 16 Section – "Inside Plant Communications Circuits."

List additional firestop product installation requirements above as applicable to this project.

3.5 TERMINATION EQUIPMENT

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Copper Building Entrance Protectors (BEPs): Provide BEPs in sizes and quantities as shown on the Contract Documents and as required for protection of building-to-building copper circuits. Provide protector's in sufficient quantity to protect each pair of each cable plus an additional 10% for future use. Install BEPs per manufacturer's instructions. Route outside plant copper cables through a BEP.

1. Connect each BEPs protector ground lug to the nearest TGB with a #6 AWG copper grounding conductor.

B. OSP Copper Data Station Entrance Protectors: Provide Protectors in quantities as shown on the Contract Documents and as required for protection of OSP copper data circuits. Install Protectors per manufacturer's instructions. Route outside plant copper cables through a Protector.

1. Connect each Protector's ground lug to the nearest TGB with a #10 AWG copper grounding conductor.

List additional termination equipment product installation requirements above as applicable to this project.

3.6 GROUNDING AND BONDING

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. All grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, and UL 467, ANSI/TIA/EIA standards and the references listed in PART 1 – REFERENCES above, as well as local codes which may specify additional grounding and/or bonding requirements.

Verify and edit referenced section titles.

B. Bond non-current carrying metal telecommunications equipment and materials to the nearest TGB (if within a building – as specified under Division 16 Section - "Grounding for Communications Circuits and Raceway") or the nearest grounding conductor if in the outside plant.

1. Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.

List additional grounding/bonding product installation requirements above as applicable to this project.

3.7 CONNECTORS/SPLICES

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Fiber Splices (Pigtails): Provide fusion-type fiber splices for connector pigtails (at the patch panels). Fiber splices are not permissible anywhere else in the system. Protect each fusion splice in a splice tray or similar protective device that is designed to mount within the fiber patch panel. Protect bare/stripped optical fiber strands with a heat shrink or silicon adhesive sleeve to prevent exposure to moisture.

List additional connector/splice product installation requirements above as applicable to this project.

3.8 CABLE

A. For each conduit in which innerduct or cable is to be installed:

1. Test Mandrels: Clean each conduit with a wire brush and swab with clean rags a minimum of two times in the same direction until the rag comes out of the conduit clean and dry. Swab away from buildings for duct sections connected to buildings. Prove out each conduit with a minimum 16 inch long test mandrel that is ¼ inch smaller than the inside diameter of the duct.

B. General (applicable to all cable types):

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

1. Test fiber optic cable on the reel upon delivery to the job site, and again prior to installation. Permanently affix the test results to the reel and submit a copy to the Owner prior to installation. Do not install cables that fail the on-reel test. Replace any cables that fail the on-reel test at no additional expense to the Owner.

a. Test shall conform to the procedures as outlined in the paragraph entitled TESTING at the end of this specification section.

2. Install cables in compliance with ANSI/TIA/EIA requirements, BICSI practices, and manufacturers recommendations. Adhere to the requirements detailed in the manufacturer's recommendations and ANSI/TIA/EIA Standards relating to bending radius, pulling tension, other mechanical stresses, and pulling speed.

a. Monitor pulling tension on runs of 300 feet or longer. Acceptable monitoring devices are:

1) Winch with a calibrated maximum tension

2) Breakaway link (swivel)

3) In-line tensiometer

3. Set up cable reels on the same sides of maintenance holes and hand holes as the conduit sections in which cables are to be placed. Level and align reels with conduit sections to prevent

twisting of cables during installation into conduits. Pull cables into conduits from tops of reels in long smooth bends. Do not pull cables into conduits from bottoms of reels. Use a cable feeder guide (shoe) of suitable dimensions between the cable reel and the face of the duct to protect the cable and to guide it into the duct. Carefully inspect the cables for sheath defects as the cables are payed off the reel. If defects are found during the pulling operation or if the cable on the reel binds, twists, or does not pay off freely, stop the pulling operation immediately and notify the Owner's representative.

4. Cables of 1-¼ inch diameter or larger shall be equipped with factory installed pulling eyes, or install a core hitch on site. Use pulling grips for cables smaller than 1-¼ inches in diameter. Do not pound grips into the cable sheath to prevent the grips from slipping. Use a ball-bearing based swivel between the pulling-eyes or grips and the pulling strand.

5. Once pulling begins, and tension is applied to the cable, continue the pull at a steady rate. If it is necessary to stop the pull at any point, the tension shall not be released unless it is necessary to do so.

6. Do not splice cables unless specifically noted on the Contract Documents.

7. For new ductbank, install cables in the lowest available conduit in a duct bank, working up as additional cables are installed. For existing ductbanks, do not place cables in ducts other than those indicated on the Contract Documents.

8. Where cables are pulled through maintenance holes or handholes, select the same duct at both sides of maintenance holes or handholes unless specifically noted on the Contract Documents. Avoid changes in duct selections, especially in elevations, to ensure that no damage occurs to the cable sheaths and that pulling tensions are kept as low as possible.

9. Maintain a sufficient length of cable in each maintenance hole or handhole to properly rack the cable. Rack cables in maintenance holes and handholes as soon as practicable, but within one week after cable installation. Route cables in maintenance holes and handholes to avoid blocking duct access.

10. When more than one cable is being installed in a conduit, pull all cables through the conduit simultaneously.

11. Where practicable, feed cables into ducts from the end of the duct that creates the least sidewall pressure on a bend during installation (i.e. feed cable from the end closest to the bend).

12. Use pulling compound or lubricant where necessary. Use lubricants that are compatible with the cable jacket material and in accordance with the manufacturer's recommendations. Do not use soap-based lubricants. Where cable is pulled through a maintenance hole or handhole, re-lubricate the cable prior to feeding into the next duct. Immediately after cables have been installed, clean lubricant from exposed cables in maintenance holes and handholes and at termination points using dry rags.

13. Seal cable ends with end caps immediately after installation and until terminated in a termination enclosure to prevent moisture entry into the core of filled cables and to prevent damage during installation.

14. Provide a service loop long enough in the ER/TR's to reach termination equipment if moved to the farthest side of the room in the future, but no less than a minimum of 25 feet at each end.

15. Comply with the NEC 50-ft rule when installing outdoor-rated cable (i.e. do not exceed 50 feet of exposed outdoor-rated cable length within a building).

16. Cable at the backboards:

a. Lay and dress cables to allow future cabling to enter raceway (conduit or otherwise) without obstruction by maintaining a working distance from these openings.

b. Route cable as close as possible to the ceiling, floor or other corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.

c. Lay cables via the shortest route directly to the nearest edge of the backboard from mounted equipment or blocks. Support cables so as not to create a load on the equipment upon which the cables are terminated. Tie-wrap together similarly routed and similar cables and attach to D-rings vertically and/or horizontally, then route over a path that will offer minimum obstruction to future installations of equipment, backboards or other cables.

17. Cable in the Telecommunications Rooms:

a. For telecommunications rooms with ladder rack, lay cable neatly in ladder rack in even bundles and loosely secure cabling to the ladder rack at regular intervals.

18. Building Entrances: Seal conduits (both in-use and spare) that enter the building from the outside plant to prevent intrusion of water, gases, and rodents.

C. Copper Cable:

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

1. Provide copper cable in quantities and pair counts as shown on the Contract Documents.

2. Test copper cable on the reel upon delivery to the job site, prior to installation. Permanently affix test results to the reel and provide a copy to the Owner prior to installation. Do not install cables that fail. Replace failing cables at no additional expense to the Owner.

a. Conform to the test procedures as outlined in the paragraph entitled TESTING at the end of this specification.

b. Demonstrate that the test results are similar to the factory test results as shipped with the reel.

3. Terminate all pairs within a cable. Un-terminated cable pairs are not acceptable.

4. For shielded cable, bond the shield at both ends to the ground lug on the Building Entrance Protector.

5. Copper splices are not acceptable.

D. Fiber Cable:

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

1. Provide fiber optic cable in quantities, strand counts, and types (singlemode, multimode, or composite multimode/singlemode (hybrid)), as shown on the Contract Documents. Provide cable with fan-out kits for both ends.

2. Test fiber optic cable on the reel upon delivery to the job site, prior to installation. Permanently affix test results to the reel and provide a copy to the Owner prior to installation. Do not install cables that fail. Replace failing cables at no additional expense to the Owner.

a. Conform to the test procedures as outlined in the paragraph entitled TESTING at the end of this specification.

b. Demonstrate that the test results are similar to the factory test results as shipped with the reel.

3. Terminate all fiber strands within a fiber cable. The installation of “dark fiber” is not acceptable.

4. For shielded cable, bond the shield at both ends to the TGB.

5. Fiber splices are not acceptable.

List additional cable product installation requirements above as applicable to this project.

3.9 LABELING AND ADMINISTRATION

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. General: Labeling and administration shall comply with TIA/EIA 606 and standard industry practices.

B. Color Coding: Apply industry standard color coding to cable termination fields. Always apply the same color to both ends of any given cable. Cross-connections are generally made between termination fields of different colors. The color may be applied to the backboard behind the termination equipment, may be the color of a cover on the termination equipment, or may be the actual color of the insert label on the termination equipment. Use the following color code:

1. Orange: Identification of the telecommunication service (telephone company) demarcation point.

2. Green: Identification of network connections on the customer side of the demarcation point.

3. White: Identification of first-level backbone in the building containing the main cross-connect, or may be used to identify the second-level backbone in buildings not containing the main cross-connect.

4. Gray: Identification of the second-level backbone in the building containing the main cross-connect.

5. Blue: Identification of the horizontal distribution (station) cables. A blue color coding is only required at the telecommunications room end of the cable, not at the station end of the cable.

6. Brown: Identification of inter-building backbone cables.

7. Yellow: Identification of inmate phone termination fields, auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.

8. Red: Identification of key telephone systems.

C. Termination Equipment:

1. Copper Building Entrance Protectors:

a. Label each BEP on the outside with a minimum of ½ inch high lettering that clearly indicates the building at the opposite end of the cable. Label each BEP on the inside with details for each cable terminating in the panel: the cable identifier, the cable pair-count and the building at the opposite end of the cable.

1) Example: A BEP used to terminate a 100-PR cable identified as “C12” from Building “A” would have the following label on the outside of the BEP: “Building A”. Another label would be located inside the BEP and would read “C12, 100-PR, Building A.”

2. Fiber Patch Panels:

a. Outside the panel: Label fiber patch panels on the outside with a minimum of ½ inch high lettering that clearly indicates the building at the opposite end of each cable. In addition, label patch panels with a patch panel designation label as follows:

1) General: Label patch panels sequentially within a given closet. Labels shall be of the form “R#-FPP#” where “R” stands for “Rack”, “#” is the sequential rack number within a given closet, “FPP” stands for “Fiber Patch Panel” and “#” is the sequential fiber patch panel number within that rack.

a) Example: The second campus fiber patch panel within Rack 1 would have the label “R1-FPP2”.

b. Inside the Panel:

1) General: Label patch panels with a single label which details the following information for cables terminating in the panel: The cable identifier, the building at the opposite end of the cable, the telecommunications room at the opposite end of the cable, the fiber type (62.5/125µm multimode, 50/125µm multimode, singlemode, composite) and the strand counts.

2) Connector Panels: Label each connector panel with the cable identifier (“F#”) of the fiber cable terminating in that connector panel.

a) Example: Connector panel “B” terminates the first twelve strands of campus backbone fiber cable “F4”. The label would be “F4.”

b) Example Connector panel “C” terminates the second twelve strands of campus backbone fiber cable “F4”. The label would be “F4.”

3) Ports: Label each duplex port with the tube and strand color/number nomenclature in the form of “tube:strand/strand”.

a) Example: The duplex port terminating the rose-colored strand and the aqua-colored strand in the blue tube within fiber F22, would be labeled “blue:rose/aqua.”

D. Grounding/Bonding Conductors: Label bonding conductors “WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!”

E. Cable:

1. Copper Cables: Labels shall include the cable identifier in the form of “M#” where “M” is the cable media type (“C” for “administrative copper” media or “I” for “inmate copper” media) and “#” is the sequential cable number for that cable type (as assigned on the Contract Documents), the origination and destination building names and telecommunications room identifiers, the pair count and cut length.

a. Example: The 350 foot long, 100-PR campus copper backbone cable identified on the Contract Documents as “C2”, terminating in telecommunications room “1A” within Building “G” and in telecommunications room “2A” within Building “H”, would be labeled with the following information: “C2”, 100-PR, 350-FT, BUILDING “H” - “1A”, BUILDING “G” - “2A”.

2. Fiber Cables: Labels shall include the cable identifier in the form of "F#" where "F" indicates "fiber" media, and "#" is the sequential cable number for that cable type (as assigned on the Contract Documents), the origination and destination building names and telecommunications room identifiers, the fiber type(s), strand count(s), and cut length.

   a. Example: The 250 foot long, 12-strand, 62.5/125µm campus fiber backbone cable identified on the Contract Documents as "F4", terminating in telecommunications room "1A" within Building "R" and in telecommunications room "2A" within Building "T", would be labeled with the following information: "F4", 12-ST, 62.5/125µm, 250-FT, BUILDING "R" - "1A", BUILDING "T" - "2A".

3. Provide labels at each end of each cable within 24" of building entrance and again within 24" of termination point. Provide labels in each maintenance hole and handhole through which a cable passes. Label each cable immediately as it enters a maintenance hole or handhole and again just prior to exiting the maintenance hole or handhole. Where cabling is routed unexposed via innerduct through maintenance holes or handholes, provide labels on exterior of innerduct indicating contents of innerduct.

List additional label product installation requirements above as applicable to this project.

3.10 PATCH CABLES

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Installation shall be as specified in Division 16 Section – "Inside Plant Communications Circuits."

List additional patch cable product installation requirements above as applicable to this project.

3.11 TESTING

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Provide test records on a form approved by the Owner and Engineer/Designer. Include the test results for each cable in the system. Submit the test results for each cable tested with identification as discussed under LABELING AND ADMINISTRATION above. Include the cable identifier, outcome of test, indication of errors found, cable length, retest results, and name and signature of technician completing the tests. Provide test results to the Owner and Engineer/Designer for review and acceptance within two weeks of Substantial Completion.

   1. Print test records for each cable within the system directly from the tester and submit in paper form (in a binder) and in electronic form (on diskette or CDROM) to the Owner and Engineer/Designer for review. Handwritten test results will not be accepted.

B. Test the SCS after installation for compliance to all applicable standards as follows:

   1. Copper Backbone Distribution: Test copper cable on the reel upon delivery to the job site, again prior to installation, and again after installation.

      a. Test all cable pairs for length, shorts, opens, continuity, polarity reversals, transposition (wire map), and the presence of AC voltage. All pairs shall demonstrate compliance to TIA/EIA 568-B Category 3 standards.

      b. Test entire channel, from termination block to termination block.

c. Use a TIA/EIA Level III testing instrument, re-calibrated within the manufacturer's recommended calibration period, with the most current software revision based upon the most current TIA/EIA testing guidelines, capable of storing and printing test records for each cable within the system.

1) Fluke DSP-4000 with latest software and hardware releases, or approved equal.

2. Fiber: Test fiber cable on the reel upon delivery to the job site, again prior to installation, and again after installation.

a. Prior to testing, calculate the cable loss budget for each fiber optic cable and clearly show the result on the test documentation. Calculate maximum loss using the following formula, assuming no splices:

1) For Backbone Distribution:

a) Max Loss = [(allowable loss/km) * (km of fiber)] + [(.3db) * (# of connectors)]

b) A mated connector to connector interface is defined as a single connector for the purposes of the above formula.

c) A given fiber strand shall not exceed its calculated maximum loss (per the above formula).

b. Test all strands using a bi-directional end-to-end Optical Transmission Loss Test Instrument (OTDR) trace performed per ANSI/TIA/EIA 455-61 or a bi-directional end-to-end power meter test performed per ANSI/TIA/EIA 455-53A, and ANSI/TIA/EIA 568-B, and the Avaya Communication SCS Field Testing Guidelines (latest edition).

1) Calculate loss numbers by taking the sum of the two bi-directional measurements and dividing that sum by two.

2) Provide test measurements as follows:

a) For Multimode Cable: Test at both 850 and 1300nm.

b) For Singlemode Cable: Test at both 1310 and 1550nm.

c. Test results shall conform to:

1) The criteria specified in ANSI/TIA/EIA-568-B

2) The Contractor's calculated loss budget above

3) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)

a) In addition to the above, perform tests both recommended and mandated by Avaya. Tests shall confirm/guarantee compliance to Avaya Ethernet GigaSPEED 1000B-X performance, and IEEE 802.3z for a maximum end-to-end dB loss of 2.5 dB.

4) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)

C. Identify cables and equipment that do not pass to the Owner and Engineer/Designer. Determine the source of the non-compliance and replace or correct the cable or the connection materials, and retest the cable or connection materials at no additional expense to the Owner. Provide new test results to the Owner and Engineer/Designer in the same manner as above.

1. In addition to the above, if it is determined that the cable is at fault, remove the damaged cable and replace it with a new cable. Cable “repairs” are not acceptable. The procedure for removing the cable shall be as follows:

   a. Prior to removal of damaged cable and installation of new cable:

      1) Inform the Owner and Engineer/Designer of the schedule for the removal and installation.

      2) Test the new cable on the reel per paragraph B, above.

      3) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.

      4) Provide test results to the Owner and Engineer/Designer for approval by the Owner and Engineer/Designer.

   b. Remove the damaged cable and provide new cable.

   c. After the removal of the damaged cable and installation of the new cable:

      1) Test the new cable per the paragraph titled TESTING.

      2) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether they are new cables installed as part of this project or existing cables installed prior to this project.

         a) If any of the cables requiring testing are in use, coordinate with the Owner to schedule an outage opportunity during which the testing can be performed.

      3) Provide test results to the Owner and Engineer/Designer for approval by the Owner and Engineer/Designer.

   d. If a cable which occupies the same innerduct or conduit (if not in innerduct) as a damaged cable is damaged by the extraction and installation process, replace the cable at no additional expense to the Owner.

      1) Damaged cables which are replaced shall be subject to the testing procedures of the paragraph titled TESTING.

List additional testing requirements above as applicable to this project.

3.12 FOLLOW UP

Review any contractor follow-up requirements with the DOC project manager and clearly state these requirements in the following paragraph(s).

A. For the first four weeks that the system is in full operation, provide technical assistance for trouble shooting, training, and problem solving by phone and (within 24 hours of notice) on site. Provide up to 40 hours of assistance (in addition to any warranty-related work), including phone, travel, and on site time during this period.